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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND
CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY

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“Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exulta; malè doctis et barbaris semper inimica fuit.”—LINNÆUS.

“Quel que soit le principe de la vie animale, il ne faut qu’ouvrir les yeux pour voir qu’elle est le chef-d’œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations.”—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. The sylvan powers
 Obey our summons; from their deepest dells
 The Dryads come, and throw their garlands wild
 And odorous branches at our feet; the Nymphs
 That press with nimble step the mountain thyme
 And purple heath-flower come not empty-handed,
 But scatter round ten thousand forms minute
 Of velvet moss or lichen, torn from rock
 Or rifted oak or cavern deep: the Naiads too
 Quit their loved native stream, from whose smooth face
 They crop the lily, and each sedge and rush
 That drinks the rippling tide: the frozen poles,
 Where peril waits the bold adventurer’s tread,
 The burning sands of Borneo and Cayenne,
 All, all to us unlock their secret stores
 And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.



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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

"..... per litora spargite muscum,
Naiades, et circùm vitreos considite fontes :
Pollice virgineo teneros hîc carpite flores :
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas ;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. 1.

No. 85. JANUARY 1865.

I.—*On the British Arctia.* By CHARLES C. BABINGTON, M.A.,
F.R.S., Professor of Botany in the University of Cambridge.

IN former volumes of these 'Annals' (ser. 1. iv. 253 ; ser. 2. xvii. 369 ; ser. 3. ii. 351) I endeavoured to define the British species of the genus *Arctium*, and hoped at the time that I had cleared up most of the difficulties attending them, but well knew that some points, and those not unimportant, remained in doubt. It is now my wish to make a few additional remarks upon these plants, because information which has been gradually obtained has shown that some of the conclusions formerly arrived at are not well founded. In the pursuit of truth we often have to alter our views ; and truth now requires me to announce a change, and to acknowledge that I have certainly been in error in not a few of my former ideas—ideas which I have continued to hold until very recently. This reconsideration of the subject has been chiefly caused by the remarks of my valued and learned correspondent, M. F. Crepin, of Gand. Before he had seen my papers in these 'Annals,' that eminent botanist pointed out that three well-defined species of *Lappa*, as he names the genus, exist in Belgium*, namely *Lappa tomentosa*, Lam., *L. minor*, DC., and *L. major*, Gaertn. He states that the former is well

* Notes sur quelques Plantes rares ou critiques de la Belgique, fasc. i. p. 15.

distinguished from the other two by the "renflement supérieur du tube de la corolle glanduleux, large, arrondi à la base et resserré à la naissance des dents; celles-ci dressées-conniventes; base de la corolle très-renflée, accrescente, aussi large que le sommet du fruit qu'elle couronne jusqu'à la parfaite maturité."

These characters are very well shown by a specimen contained in Wirtgen Herb. Pl. crit. select. (No. 607), to which M. Crepin refers me for an example of the true plant, except that in the dry or softened specimens I am unable to detect with perfect certainty the glands upon the inflated upper part of the corolla. I can see the probable remains of them in tolerable abundance. The corolla is very broad at the base, almost, as M. Crepin justly remarks, as broad as the top of the fruit. It narrows quickly, and is then cylindrical and slender up to the insertion of the stamens; there it is suddenly enlarged to a great extent, then narrows slightly upwards, and is again somewhat suddenly contracted (constricted, narrowed as if by the pressure of a string) at the base of the teeth, which do not spread, but rather converge round the cohering anthers.

M. Crepin also states that the petioles of the radical leaves of the true *A. tomentosum* are hollow.

A plant long cultivated, or rather naturally reproducing itself, in the Cambridge Botanic Garden appears to me to be the *Lappa tomentosa* (Lam.), as defined by M. Crepin. Its inflorescence is corymbose, the central stem and (most, if not all) the branches ending in corymbs raised upon long leafless stalks. Occasionally there is a small leaf at the base of the corymb, and sometimes a leaf, or rather bract, is found upon one or more of its branches, or at the base of one or more of the heads. The stem and all its subdivisions are covered by a tolerably thick coat of short crisped pubescence. The heads are nearly spherical, with the under side slightly flattened when young. By the time that the flowers expand, they have become umbilicate at the base, and, of course, widened at the top, but otherwise retain their very spherical shape: measured in their widest part (from the end of the spinous hooked phyllaries of one side to those of the other), they are about an inch in diameter, or less. They are always very thickly covered with a fine white web.

The corolla is broad at the base, but narrows immediately: its divisions are about equal in length—the lower slender and cylindrical, the upper very much inflated from its rounded base to the base of the teeth, where it is again narrowed in a marked manner; the teeth themselves converge and clasp the stamens. This inflated part of the corolla is covered with minute "glands," which are not easily seen except by the aid of a powerful glass.

The petiole has the usual angles, but they are only slightly

prominent; and the upper side cannot be called furrowed, for it is not more excavated than the other spaces (if so much), and there is a faint ridge in its middle. The petiole has a rather small oval tube running through it. The proportions of the leaf are 8 in length by 7 in breadth, exclusive of the basal lobes, which project downwards considerably. It is not very wavy at the margin, which is fringed with rather distant minute teeth. It is flat in its general position, nearly naked above, covered with fine cobweb-like down beneath.

The true *A. tomentosum* is a rare plant in France and Belgium. Fries marks it as universally distributed in Denmark, Gothland, Norway, and Sweden.

Reichenbach's plate is inconclusive. Indeed all his figures intended to illustrate the species of this difficult genus are far from being satisfactory. They represent only pieces of the plants, and do not give any good details of the flowers. His plate of *L. tomentosa* does not enable us to decide upon the identity or otherwise of his plant and that of Lamarck, Willdenow, and Crepin.

The radical leaf of a specimen of *L. tomentosa* received from Mr. J. Lange, of Copenhagen, is 10 inches long, without the basal lobes, which extend about 2 inches downwards; the broadest part of the leaf is at the insertion of the petiole, where it is 8 inches wide; it narrows gradually upwards, but is blunt at the end. Apparently it is not very, if at all, wavy at the edge; nor is it either lobed or crenate, but is fringed with rather distant, small, sharp, rigid apiculi.

As far as I have been able to learn, we cannot claim this plant as a native of Britain; and it becomes necessary to try and determine the real denomination of the plant which I have hitherto called by that name.

Before entering upon this question, it may be well to state the reasons which caused me to believe that *A. tomentosum* was a native of this country.

Sir J. E. Smith published (Eng. Bot. t. 2478) a plate and description of a plant, obtained from near Beccles, with the name of *Arctium Bardana* (Willd.), which is a synonym of the older name, *Lappa tomentosa* (Lam.). As far as I could judge, he was correct in his nomenclature, except that he had overlooked the older name. I therefore drew up, from specimens of what seemed to be the plant of 'English Botany,' the description of my *A. tomentosum*, being confirmed in my belief of being correct by finding that that plate was constantly quoted without doubt as a representation of the plant of Lamarck and Willdenow. No person seems to have suspected that it was not exactly a figure of any real species; but we now learn from the original

drawing, preserved in the Botanical Department of the British Museum, that Smith (as was unfortunately too common) caused Sowerby to alter his drawing before making the engraving, by adding greatly to the wool on the heads, making the florets protrude more from the involucre, and drawing them with the limb of the corolla more inflated. (The plate of *A. Lappa* is much more altered, and therefore even less satisfactory.)

The first fact that shook my confidence in the correctness of my nomenclature was the discovery that a very different plant was cultivated in the Cambridge Botanic Garden as *A. tomentosum*; and I soon also found wild plants exactly like my *A. tomentosum*, but nearly or quite devoid of web-like down. This astonished me considerably; but as I had been taught to consider such down as very variable in quantity, and as Fries says ('Nov.' 264) that the heads are sometimes nearly glabrous, I supposed the name to be bad, and the species to exist sometimes with webbed and sometimes with glabrous heads. But what still more surprised me was my not being able latterly to find any plants of the supposed *A. tomentosum* possessing the web. In the third of his fasciculi of 'Notes,' M. Crepin remarks with wonder that I have not taken any notice of the peculiar shape and glandular condition of the corolla of *A. tomentosum*, and also that I state the petioles of that plant to be solid; whereas he finds that structure of the corolla and a hollow petiole to be always present in his (the true) *L. tomentosa*. After a careful reconsideration of these remarks, and a re-examination of my specimens and of living individuals, I have convinced myself that my *A. tomentosum* is not the plant of Lamarck and Willdenow, and that the figure in 'Eng. Bot.' of *A. Bardana* is incorrect. I think that our *A. tomentosum* must be joined to *A. majus*. There is often considerable difference in the look of the plants, but next to none in characters—certainly not more, as I now think, than will admit of their being forms of one species.

If, therefore, my *A. tomentosum* is only a state of *A. majus*, that species is much simplified. It is the only British species which has the heads arranged in a corymb, and has constantly solid petioles. In what I consider as its typical form, the involucre are quite glabrous and green, and are so full of fruit as to be hemispherical and very open at the top when the fruit is ripe. In the other form (my former *A. tomentosum*) the involucre are sometimes, although rarely, webbed, are always purplish, and are nearly spherical even when the fruit is ripe, owing apparently to the smaller quantity of fruit produced. These two forms seem to be reproduced from seed without much, if any, alteration: and probably some botanists will think that I might retain them as species; but that is not now my opinion.

All our other species have a racemose inflorescence and more or less hollow petioles, never truly solid like those of *A. majus*. M. Crepin expresses doubts concerning two of them (my *A. intermedium* and *A. pubens*), and it is therefore necessary to pass them carefully in review. It will be seen that such a review leads to material changes in the nomenclature, but leaves the plants otherwise very much as they were.

A. minus does not require any notice. Examination leaves it unchanged, except that the remark should be added that the young heads are not umbilicate, but nearly flat below. It is often a large plant, but has very small heads arranged in a raceme.

I formerly stated that the lower leaves of my *A. intermedium* were roundish cordate, and apparently shorter in proportion to their length than those of the other species. These statements are erroneous. At that time I had scarcely any knowledge of the true radical leaves—indeed, had probably never seen them. The only tolerably large leaf on my specimen from Berwickshire is not nearly radical, but has a flowering branch springing from its axil; and my other specimens are equally destitute of the lower leaves. My acquaintance with the plant was confined to the possession of a few dry specimens.

During a recent visit to Caernarvonshire, my friend Mr. Newbould directed my attention to an *Arctium* which is abundant about Llanberis, and expressed his belief that it is the *A. intermedium*. He is to a considerable extent correct in this idea, for it does seem to be my *A. intermedium*; but it is not that of Lange, as is shown by his plate in the 'Flora Danica' (t. 2663). Most probably our *A. intermedium* is the *A. nemorosum* of Lejeune. It accords admirably with his character and remarks (Compend. Fl. Belg. iii. 129); its young heads are "ovate" and "floccose," and ultimately become thick and large; in arrangement they are "interrupte racemosa subspiciformia;" its radical leaves are "cordate-oblong;" its stem is nearly erect. Thus our plant has all the special characteristics of *A. nemorosum* except "foliis utrinque viridibus," for they are white beneath. We shall therefore probably be justified, indeed I might say required, to give Lejeune's name to the English *A. intermedium*.

Lange's specimen accords very well with his plate in 'Flora Danica.' It has a very different radical leaf from the supposed *A. nemorosum*. Were that not the case, they might probably be combined. As I have found the form of those leaves to be very constant, I cannot admit of such a union, although it is suggested by M. Crepin. Reichenbach's plate of *A. intermedium* doubtless represents the true plant. The leaves of *A. intermedium* are deeply cordate, not cordate-oblong.

The *A. nemorosum* has leaves much longer in proportion to

their width than those of the other species, and they even seem narrower than they really are, from the sides being turned up in such a manner as to present their edges to the spectator. When so seen alive, the leaf therefore appears exceedingly long and narrow. In the other species I believe that the leaves are nearly flat, except that they form a slight angle at the middle, and the basal lobes are often incurved. Also the leaves of *A. nemorosum* are blunter than those of the others. These facts give a very characteristic appearance to the leaves, and are apparently their constant condition. We examined very many individuals, and always found this kind of leaf upon them. A large leaf now before me, which has, of course, been flattened in its preparation for the herbarium, measures $12\frac{3}{4}$ inches from the top of the petiole to its upper extremity, and is 9 inches in width at a third of its length from the base. In the lower and second third it narrows very gradually, and not much quicker until the tip is nearly approached. The basal lobes extend downwards, and add fully three inches to the total length of the leaf, which thus is nearly 16 inches long. Before this leaf was flattened, it seemed to be about three inches narrower. A smaller leaf has precisely the same proportions, except that it is even a little more decidedly oblong. The petiole is nearly flat above, rather angular, and traversed by a small roundish tube. The heads, when in flower, are narrower and more ovoid than those of the other plants, because the actual flowers are scarcely inflated in their upper part, and therefore pack very closely together. These flowers (florets) are about equally divided into the slender tube and the narrow cylindrical limb; they scarcely protrude their corollas beyond the involucre, which is nearly flat-based, only slightly webbed, and green. As the seed ripens, the head increases in width more than in length, so as to become much broader than long. It continues to be nearly truncate at the base, and is so far open at the top as clearly to show the ripe fruits. The involucre often remains green, or becomes slightly tinged with purple, except the innermost phyllaries, which are purplish, thin, flat, scarcely hooked, and about as long as the others. The fruit is rugose, covered with blackish spots, narrowing very gradually from the base to the top. All the heads are very shortly stalked, and usually form a compact cluster of about three at the top, although occasionally there is only one there. The central stem has them arranged in a long narrow raceme; so also the branches.

I consider that this plant may be known by the subconvolute leaves, its narrow raceme, nearly sessile heads, close terminal group of heads, and the cylindrical (not inflated) limb of the corolla.

M. Crepin considers the *A. nemorosum* (Lej.) to be the same plant as the *A. intermedium* (Lange); but I very much doubt the correctness of that opinion. Lejeune says "anthodiis ovatis interrupte racemosis spiciformibus," which cannot easily be made to apply to my *A. pubens*, which likewise Crepin combines with *A. intermedium* and *A. minus*; nor to the plate of *A. intermedium* given by Lange in the 'Flora Danica.' The inflorescence of these plants is doubtless racemose, but certainly not spiciform. I do not consider the cluster of heads at the end of each branch to be of the least value as a character; for a spike-like raceme easily acquires that structure.

I still think that my *A. pubens* is distinct from *A. minus*, notwithstanding M. Crepin's remarks. It has the structure of the true *A. intermedium* of Lange, and apparently ought to bear that name. Its heads are at least double the size of those of *A. minus*. Lange defines his plant as follows (Fl. Dan. t. 2663):—" *Lappa elata robusta saturate viridis vel sæpe purpurascens, foliis inferioribus magnis cordatis leviter remoteque dentatis, inflorescentia racemosa arcuate nutante, calathiis magnis leviter arachnoideis, junioribus globosis, defloratis ovatis, achenio quam in *L. minore* duplo majore.*" The leaf, as figured, measures 3 inches in length by $2\frac{1}{2}$ in width at a little above the insertion of the petiole. The raceme ends in two nearly or quite sessile heads; but the stalks of the heads become successively longer as they are more distant from the top, just as in my *A. pubens*. I consider the plate in the 'Flora Danica' to be a good representation of my *A. pubens*, except that I have not noticed the clustering of heads at the top of the raceme; and, as already stated, I do not consider this as affording any good character for a species. Doubtless the leaves of *A. pubens* are very like those of *A. minus*, being only rather broader and less acute. The inflorescence of *A. minus* is racemose, but it has not the pyramidal form caused by the longer lower peduncles of *A. pubens*. Its heads are all seated upon nearly equally short stalks, and its raceme may be called spiciform. I believe therefore that *A. pubens* is the true *L. intermedium* of Lange, and ought to bear that name. Crepin thinks that the length of the peduncles varies according to the strength of the individual plant; but my observations do not lead me to the same opinion. With us *A. minus* often rises to a greater height than either of the other plants, nevertheless it seems always to retain its shortly stalked heads. My *A. pubens* is usually a plant of rather small stature, although robust, and its lower are always seated upon much longer stalks than its upper heads.

The leaf of *A. majus* is different in proportion from those of *A. minus* and *A. nemorosum*. It is very uniform in shape: one

now before me is 12 inches long (exclusive of the lobes, which add $2\frac{1}{2}$ inches to the length); its width at the insertion of the petiole is also fully 12 inches, and it narrows gradually and uniformly from thence to near the tip, when it suddenly contracts to a blunt end. It is therefore much broader in proportion to its length than the leaves of those plants. As already stated, its petiole is always solid. The hollow petioles of the others have the woody fibres collected towards the circumference, there being none even adjoining the tubular central space, which is bounded by cellular tissue, although well defined in form and apparently not a result of the mere rupture of that tissue.

It only remains to define the species as I understand them. The following table may be of use as pointing out the characters by which they may usually be known.

- | | |
|--|-------------------------|
| 1. Upper division of the corolla inflated, rounded at the base, constricted below the teeth, glandular; base of the corolla much widened. Inflorescence corymbose. | <i>A. tomentosum</i> . |
| Upper division of the corolla not inflated or rounded at the base, bell-shaped or cylindrical, not constricted or glandular; base of the corolla not much widened | 2. |
| 2. Inflorescence corymbose. Petioles solid | <i>A. majus</i> . |
| Inflorescence racemose. Petioles hollow | 3. |
| 3. Radical leaves cordate-oblong. Heads subsessile | <i>A. nemorosum</i> . |
| Radical leaves cordate. Heads manifestly stalked | 4. |
| 4. Inflorescence racemose. Heads all shortly stalked, small | <i>A. minus</i> . |
| Inflorescence racemose-pyramidal. Lower heads long-stalked, uppermost subsessile | <i>A. intermedium</i> . |

1. *A. tomentosum* (Schkr.); *inflorescentia corymbosa, capitulis pedunculatis arachnoideis, squamis involucri floribus brevioribus, parte superiore corollæ glandulosa ad basin ventricosa sub dentibus constricta* tubum ejus æquante, tubo corollæ ad basin fructus latitudinem subæquante, petiolis fistulosis, foliis radicalibus cordato-ovatis subintegræ apiculato-dentatis.

A. tomentosum, Schkr. *Handb.* iii. 49, t. 227 (1803); *Pers. Syn.* ii. 383 (1807).

A. Lappa, *Fl. Dan.* t. 642; *Sven. Bot.* t. 63.

A. Bardana, *Willd. Sp. Pl.* iii. 1632 (1800).

Lappa tomentosa, *Lam. Fl. Fr.* ed. 1. ii. 37 (1778); *DC. Prod.* vi. 661; *Rehb. Icon. Fl. Germ.* xv. 80.

L. major ex omni parte minor capitulis parvis eleganter reticulatis, *Dillen. in Raii Syn.* ed. 3. 197.

Bardana capite araneoso. Cobweb-headed Burdock, *Pet. Eng. Pl.* t. 23. f. 6.

Stem about 3 feet high; top and each of the branches ending in a well-formed corymb of heads. Heads rather small, spherical, umbilicate, very thickly webbed. Radical leaves rounded at

the end, not much longer than broad*, nearly entire, edged with numerous rigid apiculi.

I have very little doubt of this being the plant intended by Ray or, rather, Dillenius and Petiver. It is stated in the 'Synopsis' to have been found by Mr. J. Sherard; but no place is mentioned. Its claims to be an English plant rest upon this very slender authority; and I think that it should not be admitted into our lists at present, although not an unlikely plant to inhabit this country.

2. *A. majus* (Schkr.); *inflorescentia laxe subcorymbosa, capitulis pedunculatis* glabris vel subglabris (maximis), squamis involucris flores subæquantibus, parte superiore corollæ quam tubus ejus multo brevior campanulato glabro ad basin attenuato sub dentibus nunquam constricto, tubo corollæ undique fructu multo angustiore, *petiolis farctis*, foliis radicalibus cordatis subintegris apiculato-dentatis.

A. majus, Schkr. *Handb.* iii. 49 (1803); *Fries*, Nov. 264.

A. Lappa, Willd. *Sp. Pl.* iii. 1631.

A. tomentosum, Bab. in *Ann. Nat. Hist.* ser. 2. xvii. 371; *Man. Br. Bot.* ed. 4. 184.

Lappa major, Gaert. *Fruct.* ii. 379, t. 162 (1791); *DC. Prod.* vi. 661 (1837).

L. officinalis, Rchb. *Icon. Fl. Germ.* xv. 54, t. 81.

Bardana vulgaris. Burdock, *Pet. Eng. Pl.* t. 23. f. 1.

Stem 3-4 feet high; top and usually most of the branches ending in loose irregular corymbs of heads. Heads large, spherical when in flower, but not umbilicate, often hemispherical with fruit, usually quite naked, but sometimes slightly webbed, green or purplish. Radical leaves blunt, as broad as or broader than long, broadest at the insertion of the petiole; petioles quite solid, with prominent angles, deeply furrowed above.

Possibly Gaertner's plant was not of this species; for he quotes 'Fl. Dan.' (642). But his figure shows no wool on the head. When he wrote, the species were not distinguished.

This is the only species which is known to possess solid petioles.

This seems to be pretty generally distributed, but is not so frequent as *A. minus*.

3. *A. intermedium* (Lange); *inflorescentia racemoso-pyramidalis, capitulis arachnoideis inferioribus longe pedunculatis summis subsessilibus*, squamis involucris flores æquantibus, parte superiore corollæ tubo ejus subæquali campanulata ad basin

* In measuring the leaves, the basal lobes are omitted in all cases. The base of the leaf is considered to be the point where the petiole is inserted.

attenuata sub dentibus nunquam constricta glabra, tubo corollæ undique fructu multo angustiore, petiolis fistulosis, foliis radicalibus cordatis grosse crenatis crenis apiculatis.

A. intermedium, *Lange, Dansk. Fl.* ed. 1. n. 1000 (1850).

A. pubens, *Bab. in Ann. Nat. Hist.* ser. 2. xvii. 376 (1856); *Man. Br. Bot.* ed. 4. 185.

Lappa intermedia, *Rehb. Icon. Fl. Germ.* xv. 54, t. 81; *Fl. Dan.* t. 2663.

Stem 3–4 feet high, erect to the top, and, as well as the spreading branches, racemose; lower peduncles longest. Heads rather large, ovoid, not umbilicate, hemispherical with fruit, greenish, clothed with a thick web when young, but becoming nearly naked afterwards. Corolla nearly cylindrical in the upper enlarged part, but narrowing gradually below into the tubular slender lower part. Radical leaves rather acute, about as long as broad, broadest at the insertion of the petiole; petioles hollow, scarcely angular, only slightly but broadly furrowed above.

The very broad, rather acute, radical leaves with hollow petioles, and the rather large heads arranged in a racemose, not subspicate, manner, will usually distinguish this plant, which is probably not of uncommon occurrence.

4. *A. nemorosum* (Lej.); *inflorescentia spicato-racemosa, capitulis subsessilibus arachnoideis, squamis involucri flores æquantibus, parte superiore corollæ tubo ejus subæquali subcylindrica sub dentibus nunquam constricta glabra, tubo corollæ undique fructu multo angustiore, petiolis fistulosis, foliis radicalibus cordato-oblongo-ovatis subconvolutis grosse crenatis crenis apiculatis.*

A. nemorosum, *Lej. Compend. Fl. Belg.* iii. 129 (1836).

A. intermedium, *Bab. in Ann. Nat. Hist.* ser. 2. xvii. 374; *Man. Br. Bot.* ed. 4. 184.

Stem 3–4 feet high, its top and the tops of the branches usually nodding, bearing spike-like racemes of nearly sessile heads. Heads intermediate in size between those of *A. majus* and *A. minus*, ovoid with flowers, not umbilicate, much depressed with fruit (then often twice as broad as long), green or purplish, usually clothed with a thick web. Radical leaves blunt, a third longer than broad, about equally broad throughout the lower two-thirds, somewhat convolute; crenatures very broad, but shallow, usually emarginate; petioles hollow, slightly angular, scarcely furrowed above.

The long nearly parallel-sided leaves with very broad but very shallow lobes or crenatures, each lobe being usually (if not

always) slightly emarginate with an apiculus in the notch, together with the spike-like arrangement of the heads, are marked characteristics of this species, which is very abundant in the valley of Llanberis, Caernarvonshire. I have seen what is apparently the same plant from Hope in Derbyshire, Berwick-upon-Tweed, Bembridge in the Isle of Wight, and Edinburgh; but I have not seen the radical leaves of either of these plants.

5. *A. minus* (Schkr.); inflorescentia racemosa, capitulis brevipedunculatis arachnoideis (parvis), squamis involucri floribus brevioribus, parte superiori corollæ tubo ejus subæquali subcylindrica ad basin attenuata sub dentibus nunquam constricta glabra, tubo corollæ ad basin fructu multo angustiore, petiolis fistulosis, foliis radicalibus cordato-prolongis grosse dentatis dentibus apiculatis.

A. minus, Schkr. *Handb.* iii. 49 (1803); *Fries*, Nov. 263.

A. Lappa α, Linn. *Fl. Suec.* ed. 2. 277 (teste *Fries*).

A. Lappa, Curt. *Fl. Lond.* ii. 173 (fasc. iv. 55); *Woodv. Med. Bot.* t. 15.

Lappa minor, DC. *Fl. Fr.* iv. 77; *Prod.* vi. 661; *Fl. Dan.* t. 2662. *Bardana* capite minore. Small-headed Burdock, *Pet. Eng. Pl.* t. 23. f. 3.

Stem often 4–5 feet high, its top and the tops of the branches usually nodding, bearing rather loose racemes of heads. Heads small (usually about the size of a hazel-nut), ovoid with flowers, not umbilicate, mostly globular with fruit, greenish, usually much webbed. Radical leaves acute, longer than broad, broadest at one-third above the insertion of the petiole; teeth very broad but shallow; petioles hollow, slightly angular, scarcely furrowed above.

This common plant is known by its small ovoid racemose stalked heads, and its very coarsely dentate, not crenate, leaves.

II.—*New Land-Shells from Travancore, Western and Northern India.* Described by W. H. BENSON, Esq., Retired List, Bengal Civil Service.

1. *Helix Basilessa*, B., n. sp.

H. testa anguste umbilicata, solida, depressa, striatula, sub epidermide luteo-fusca purpurascente, subtus versus umbilicum albida; spira convexiuscula, apice valde obtuso, sutura impressiuscula, demum impressa; anfractibus 5, rapide accrescentibus, ultimo antice leviter descendente, dilatato, subtus demum subplanato, supra peripheriam fascia castanea superne albida munito; apertura obliqua, transversim oblonge ovato-lunata, intus fuscescente,

peristomatis marginibus callo albido junctis, dextro rotundato, superne antice arcuatim prominente, tenuiter marginato, columellari brevi reflexiusculo, basali longe oblique descendente, intus incrassato, albido.

Diam. major. 48, minor 38, axis 21 mill.

Habitat in montibus prope Cottyam in regione Travancorica.

I am indebted for this and the following shell to Mr. F. Day, Assistant-Surgeon Madras Medical Service. The form is peculiar, and unlike that of any known Indian species.

2. *Helix Anax*, B., n. sp.

H. testa late umbilicata, subovato-discoidea, utrinque concava, solidula, superne oblique costulato-striata, subtus striata, nitidiuscula, fusco-castanea, subtus lætiore; spira immersa, apice elevatiusculo, sutura subprofunda; anfractibus 5, primis convexiusculis, ultimo convexo, antice descendente, dilatato, deflexo, ad diametrum minorem angustiore; apertura perobliqua, rotundato-oblonga, lamellis 2, parietalibus, albis, superiore longe intrante, sinuata, inferiore obliqua sinuata, brevior, ab apertura remotiuscula, palatalibus 3 longiusculis subprofundis obliquis parallelis ab apertura conspicuis extus perlucetibus coarctata; peristomate cæruleo-albido, subcalloso, breviter reflexiusculo, marginibus callo albido junctis, inferiore subdentato-incrassato.

Diam. major 23, minor $17\frac{1}{2}$, axis 8 mill. Apert. lata vix 10, longa 9 mill.

Habitat cum specie præcedente in montibus Travancoricis Mavillicurray dictis.

Four oblique parallel palatal lamellæ, similar to the three within the aperture, are visible through the shell at the commencement of the last whorl near the left lip of the peristome*.

A species belonging to the restricted form of *Corilla*, Adams, consisting of the Ceylon shells, *C. erronea*, Albers, *C. Rivolii*, Desh., *C. Charpentieri*, Pfr., and *C. Humberti*, Brot. It comes nearest to *C. erronea*, but differs in the more rounded aperture, the dark chestnut colour, the palatal and parietal lamellæ, and other characters. It is an interesting Southern Indian approach to Ceylon forms, observable also in *Cataulus recurvatus*, Pfr., and other Travancore shells. When we consider the small tracts

* In one of my Ceylon specimens of *H. Rivolii*, found in a different quarter from the rest, there are four oblique parallel lamellæ in the same position as the four remote ones near the parietal lip in *H. Anax*, and visible also from the exterior, the upper one being less plainly seen through the strong sculpture. In others they are deficient, even when sought for by cutting into the shell. In page 22 of the 'Journal de Conchyliologie' for 1864, Brot correctly states that there are four palatal lamellæ in *H. erronea* and *H. Rivolii*, instead of three as recorded by Pfeiffer. In those species their irregular relative position is very different from that which is observable in *H. Anax*.

which have come under the observation of inexperienced collectors on the outskirts of this extensive mountainous region, we may expect a large and valuable addition to conchology when the country can be explored by careful collectors. The Mavillikurray Hills are 2000 feet in height, to the east of the station of Cottyam.

3. *Helix Travancorica*, B., n. sp.

H. testa anguste perforata, subconoideo-depressa, tenui, superne oblique confertissime plicato-striata, striis confertis spiralibus granulatis decussata, subtus læviore polita, striis spiralibus versus umbilicum obsoletis; spira depresso-conoidea, versus apicem acutiusculum elevatiuscula, sutura impressa, anguste marginata; anfractibus $5\frac{1}{2}$, convexiusculis, gradatim increscentibus, ultimo ad peripheriam anguste albidam compresse carinato, subtus inflato; apertura obliqua, rotundato-lunata; peristomate tenui, margine parietali superne triangulatim reflexo.

Diam. major 29, minor 23, axis 15 mill. Apert. lat. 15, alt. 14 mill. Habitat in montibus Travancoricis non procul a Cottyam. Teste D. Kohlhoff.

A single specimen of this shell, with the surface in perfect condition, but with an injured aperture, was obtained with my most gigantic one of *Helix Basileus*. I was at first disposed to refer it to *H. Isabellina*, Pfr.; but, on comparing it with Dr. Pfeiffer's description, with a fine specimen of that shell (from Hapoorthalle) in Mr. F. Layard's collection (40 mill. in diameter and 16 in axis, having the yellowish-green epidermis in good condition), and with another specimen now in my possession, I found the Travancore form to be clearly distinct. The figure of *H. Isabellina* in Reeve's 'Conchologia Iconica' is not a satisfactory one.

On either side of the whitish carina of *H. Travancorica* the colour is somewhat deeper than on the rest of the surface. Further specimens may exhibit darker bands at this part. The gradual increase of the narrower whorls, in conjunction with the conoid spire, more elevated towards the somewhat pointed summit, when compared with the more flattened and depressed spire and more rapidly enlarged whorls of *H. Isabellina*, prove the Travancore shell to be distinct, besides its more impressed suture, its less transversely widened aperture, and its more granulate sculpture.

4. *Helix pedina*, B., n. sp.

H. testa perforata, orbiculato-depressa, tenuissima, irregulariter striatula, superne nitidiuscula, subtus nitida, translucens, fulva, vel pallide cornea; spira depressa, apice obtuso, interdum acutiusculo, sutura anguste marginata; anfractibus 6, convexiusculis, ultimo latiore, superne ad peripheriam obtuse angulato; apertura

obliqua, lunari, latiuscula, peristomate tenuissimo, intus non labiato, margine columellari superne breviter reflexo.

Diam. major 32, minor 28, axis 14 mill.

Habitat prope Bombay et Ahmednugger.

I have had specimens of this shell from Dr. Jerdon, Major H. Alexander, Mr. Fairbank, and others. Mr. Shurtleff assigns it to *H. labiata*. It has also been considered a variety of *H. vitrinoides*. Besides its great thinness, the absence of any labiation inside the peristome, and of the colours observable in the aperture of *H. labiata*, Pfr., which I discovered, in 1838, in the Western Himalaya, it is distinguished by its subangular periphery and marginate suture from that and any other allied form.

5. *Helix chloroplax*, B., n. sp.

H. testa perforata, subconoideo-depressa, tenui, superne subplicato-striata, infra striatula, tenuissime decussata, translucente, vix polita, viridescenti-cornea; spira subconoidea, depressa, apice obtuso, sutura impressa; anfractibus 5, lente accrescentibus, convexiusculis, ultimo ad peripheriam superne angulato, subtus convexo; apertura obliqua, angulato-lunari, peristomate tenui recto, marginibus remotis, columellari superne vix reflexiusculo.

Diam. vix 8, axis 4 mill.

Habitat in montibus Himalayanis prope Simla.

A single specimen was received from Mr. W. Theobald.

6. *Achatina leptospira*, B., n. sp.

A. testa oblongo-turrita, striatula, nitente, pallide fusco-cornea; spira subanguste turrita, apice obtuso, sutura profundiuscula, crenulata; anfractibus 9, convexiusculis, superioribus brevibus convexioribus, ultimo $\frac{1}{3}$ longitudinis non æquante; apertura subobliqua, elliptica, marginibus callo junctis, columellari arcuato, oblique truncato, dextro tenui.

Long. 16, lat. 6 mill.

Habitat in montibus Soomeysur dictis. Teste W. Theobald.

7. *Achatina Fairbanki*, B., n. sp.

A. testa subcylindraco-turrita, striatula, obsolete et minutissime spiraliter decussata, polita, translucente, luteo-cornea; spira versus apicem ad latera subconvexa, vertice obtuso, sutura distincte impressa; anfractibus 8, subconvexis, brevibus, 4 ultimis in diametro lente accrescentibus, ultimo subtus rotundato $\frac{1}{4}$ longitudinis æquante; apertura subobliqua, ovata, superne subtusque angulata, marginibus callo junctis, columellari leviter arcuato, oblique truncato, dextro basaliq̃ue tenuibus.

Long. 12, lat. 4 mill. Apert. long. 3, lat. $2\frac{1}{2}$ mill.

Habitat in montibus Mahabaleshwar.

The nearest Nilgiri form is *A. corrosula*, Pfr. The more

cylindrical form below, the sculpture, shorter whorls, &c., safely distinguish it. It was discovered by the Rev. S. B. Fairbank, from whom I have received a specimen of the sub-Himalayan form *Helix Barrakporensis*, Pfeiffer, obtained in the Mahabaleshwar Hills.

8. *Achatina Vadalica*, B., n. sp.

A. testa turrito-elongata, striatula, solidula, polita, translucens, luteo-cornea; spira versus apicem convexiusculo-turrita, apice obtusiusculo, sutura impressa; anfractibus 11, convexis, brevibus, superioribus costulato-striatis, ultimo subtus rotundato, $\frac{1}{4}$ longitudinis vix æquante; apertura vix obliqua, elliptico-ovata, marginibus callo junctis, columellari leviter arcuato, albido, oblique truncato, dextro basaliq. tenuibus.

Long. 34, diam. 9 mill. Apert. long. 8, lat. 5 mill.

Habitat ad Wadale prope Ahmednugger. Teste S. B. Fairbank.

The convex sides of the upper part of the spire, the shorter whorls, with the sculpture and polish of this shell, distinguish it as well from the Nilgiri *A. Perrotteti* as from the neighbouring *A. notigena*, which has an attenuate spire and costulate sculpture in all the whorls. The Liberian *A. clavus*, Pfr., is a broader shell, with longer and wider whorls.

9. *Bulimus Smithei*, B., n. sp.

B. testa perforata, ovato-oblonga, irregulariter rugoso-striata, striis tenuibus plus minusve decussata, sub epidermide cornea albida, non nitente; spira oblongo-turrita, lateribus convexiusculis, apice obtusiusculo, sutura impressa; anfractibus $7\frac{1}{2}$, convexiusculis, ultimo antice leviter ascendente; apertura vix obliqua, subovata, peristomate tenui reflexiusculo, marginibus callo tenui junctis, columellari perforationem subtegente.

Long. 13, diam. 5. Apert. long. 4, lat. $3\frac{1}{2}$ mill.

Habitat in montibus prope Roopur et Fagoo.

Mr. J. Doyle Smithe, F.G.S., got this shell in the hills on the right side of the river Sutlej, in the Punjab; and Mr. W. Theobald subsequently got it at Fagoo, on the Simla side of the river.

Cheltenham, Nov. 30, 1864.

P.S. On a further examination of *Helix Anax*, under light through a powerful lens, I find a fourth long basal palatal lamella within the aperture. It appears externally nearly parallel with the suture, and is indistinctly visible from the mouth. The palatal lamellæ, though equal in number to those in *H. erronea* and *H. Rivolii*, still differ in the direction in which they are placed with reference to each other.

III.—On the Circulation of the Blood in the Spiders of the Genus *Lycosa*. By EDOUARD CLAPARÈDE*.

THE circulation of the blood in the Arachnida has already been the subject of profound investigations. Those of Newport on the circulatory organs of the Scorpion† in particular enjoy a credit to which they are entitled in the highest degree. They have been completed and at the same time corrected in some points of detail by Blanchard. The latter has also bestowed on science some splendid investigations of the circulatory organs of other sections of the Arachnida. He has in particular devoted a considerable part of his Memoirs to a Spider of the genus *Mygale*. At this moment he is publishing some magnificent plates of the anatomy of the Arachnida‡; and although the text relating to the Spiders has not yet appeared, it is easy to see, from the plates already published, the results at which he has arrived.

It will be seen that on more than one point I cannot agree with M. Blanchard; but none the less do I accord my tribute of admiration to the labours of that learned anatomist, and this without any reservation. M. Blanchard has resorted to the method of injection already practised by Dugès, Newport, and others. I believe that he has obtained from it everything that it can be made to furnish. By its means he has recognized with perfect accuracy all the principal vascular trunks; but nevertheless this method has not always informed him with perfect certainty of the direction of the circulation of the blood in the vessels. Moreover it has frequently spread for him a snare, in which so many anatomists have allowed themselves to be taken under other circumstances. M. Blanchard has too often thought that he found sanguiferous networks, when he had under his eyes only the meshes of an artificial net hollowed out by the injected material in the delicate tissues. Once more he has shown how necessary it is that the method of injections should be submitted to a severe check, if we would not reproduce the exaggerated discredit into which it has fallen in the eyes of more anatomists than one.

I have followed quite a different course. I have endeavoured to procure young Spiders so transparent as to allow the course of the blood to be investigated in its full activity. The most favourable object that I have hitherto met with is the *Lycosa saccata*, Hahn. The females of this species carry their ovigerous sac applied to the posterior part of their abdomen. The young

* Translated by W. S. Dallas, F.L.S., from the 'Annales des Sciences Naturelles,' Nov. 1864, p. 259.

† Phil. Trans. 1843, part 2, p. 213.

‡ L'Organisation du Règne Animal, par Emile Blanchard: Arachnides, livr. 1-16.

individuals already hatched, but still contained in this sac, were employed by me in my researches. It will not, perhaps, be useless to those who may wish to repeat my observations, to remark that the young *Lycosæ*, like most of the other Spiders, undergo a moult in the interior of the ovigerous sac. The individuals which have already undergone this moult, or in which it is approaching, are unfit for observation. The former bristle with opaque hairs; and the latter already present, beneath the integument which they are about to throw off, the hairs characteristic of the following phase. It is therefore immediately after hatching, and before the preparations for the moult, that the *Lycosæ* must be studied, if we wish distinctly to recognize their circulatory apparatus. Even at this period, the young individuals possess a great resemblance to the adult. All the organs are formed, with the exception of the abdominal portion of the digestive tube, with its appendages, and the reproductive organs. The intestine and the glands which are dependent on it (liver, urinary glands) are represented by a strongly refractive mass of a brownish-yellow colour—the unassimilated residue of the vitelline emulsion which formerly filled the membrane of the egg. In the cephalothorax we also find a residue of the vitellus enclosed in an annular stomach and its cæcal diverticula.

The heart, or dorsal vessel, is situated on the median line, exactly following the curve of the dorsal surface. Seen in profile, it seems to describe nearly a semicircle. It presents its maximum breadth in the immediate vicinity of the abdominal peduncle, and from this point it gradually diminishes in calibre to its posterior extremity. Its transverse section is not circular, but elliptical, or, rather, reniform, the greater convexity of this section being turned upwards. At different parts the heart presents lateral dilatations, or, rather, diverticula, arranged in pairs. These diverticula are of the form of wide cones, of which the base is continued into the wall of the heart. There are three pairs of them, and the last are much less developed than the preceding ones. Sometimes I have fancied that I could see a fourth, still further back; but with regard to this I have not been able to arrive at certainty. At the level of each pair of diverticula there is a pair of those orifices like button-holes which were first discovered by Strauss in Insects, and which so many anatomists have since detected in the most diverse forms of Arthropoda. I shall retain for them the name of *venous orifices*, rather than that of *atrioventricular apertures*, which has often been given to them. These apertures are not exactly transverse, but oblique, their dorsal or inner angle being directed a little forwards, and their outer angle a little backwards. This latter advances slightly beyond the limits of the heart properly so

called, and is cut into the back of the base of the conical diverticula which I have just described. The orifices of the foremost pair are the largest, the next are a little smaller, and those of the third pair the least of all. All these pairs serve for the afflux of the blood into the heart at the moment of diastole. Under the microscope, the blood-globules are seen to engulf themselves in them at each dilatation.

At this period of life the heart is not divided into several chambers by internal folds or valves; but I cannot say whether this is the case also in the adult. I know that Newport and Blanchard have found these valves in the heart of the Scorpion, and I have no doubt that their observations are perfectly correct. But nothing of the kind exists in the young *Lycosæ*. The venous orifices, which gape widely during diastole, close during systole, and thus prevent the blood which they have allowed to pass from returning. This closing seems to be effected by the action of the muscular fibres which form the margins of the orifice. These fibres present one large nucleus or an agglomeration of nuclei towards the middle of the margins of each orifice. At the moment of the closure of the orifice (which immediately precedes the systole of the heart), the nuclei of the opposite margins of each orifice are seen to apply themselves energetically to each other. Moreover the entire wall of the heart is beset with nuclei, which, however, are a little less apparent than the above. These are no doubt the nuclei of muscular cells, the presence of which is indicated by the transverse striæ of the wall of the heart.

The heart receives the blood only through the six orifices which I have just described, at least unless there is a fourth pair of such apertures. Indeed M. Blanchard, who represents the heart in *Mygale* as simply cylindrical, ascribes to it four pairs of atrioventricular apertures. But the place where this fourth pair of apertures should be found in the *Lycosæ* is generally so well masked by vitelline granules that I have never succeeded in seeing it.

Let us now consider the issues through which the blood escapes from the heart to take its way to the organs. In the first place we find the thoracic aorta originating from the anterior extremity of the heart, as has been recognized by all the anatomists who have investigated this subject. But it is only a small portion of the blood that is driven by the heart into this vessel. When the young Spider is placed so as to be seen in profile, we perceive that it is only the *cul-de-sac* comprised between the first pair of orifices and the origin of the aorta that sends its blood into that vessel. The pneumocardiac current, which penetrates into the heart through these orifices, divides

immediately into two branches, one of which bends forwards to reach the aorta, whilst the other curves backwards so as to continue its course as far as the posterior extremity of the heart, receiving in its passage affluents from the other apertures. It is thus only the shortest portion of the heart that drives the blood in the same direction as the heart of the other Arthropoda. It is true that, if this portion is short, it is at the same time the widest part of the dorsal vessel.

The posterior part of the dorsal vessel is simply tubular, and may bear the name of the *posterior* or *caudal aorta*. It penetrates into the apex of the abdomen, which may be called the *pygidium*, where it is found gaping widely into a lacuna which occupies this pygidium and the base of the spinners. The form of this orifice is oval; under the microscope it is seen to be constantly giving passage to a large stream of blood which pours into the lacuna of the pygidium.

No doubt these are not the only apertures by which the blood quits the heart. I have described above the conical processes or diverticula which this viscus presents at the level of each pair of venous apertures. These processes are prolonged into whitish bands, which turn round the sides of the body, and descend towards the ventral region of the abdomen. I regard these bands as arteries; but I must admit that, as these organs are only of small diameter, and repose upon a somewhat opaque vitelline mass, I have never succeeded in seeing blood-globules moving in their interior. Hence I cannot arrive at complete certainty upon this point. I am aware that, according to M. Pappenheim*, the heart in Spiders does not present any trace of lateral vessels, and gives origin to vascular trunks only at its two extremities; but I cannot attach very great importance to the assertions of this anatomist, seeing that he represents the heart in Spiders as enclosed in a pericardium which presents no aperture. He thus appears implicitly to assume that one extremity of the heart is venous and the other arterial, and seems to have had no knowledge of the lateral orifices. This notion is radically wrong; and M. Pappenheim may equally well have deceived himself with regard to lateral arteries. I would rather rely upon the old but skilful dissections of Treviranus, who found lateral arteries in the heart of *Tegenaria domestica*; moreover it would be an arrangement exactly conformable to that described by Newport in the Scorpions.

It is true that M. Blanchard, resuming a theory which was only doubtfully put forward by Dugès†, regards these organs

* Comptes Rendus, 1848, tome xxvii. p. 159.

† Additions au Mémoire de M. Dugès sur les Araignées (Ann. Sc. Nat.

as pneumocardiac vessels conducting the blood from the respiratory organs to the pericardium, and consequently indirectly to the lateral orifices of the heart. But this opinion is decidedly false, seeing that these vessels directly reach the heart. Their cardiac origins, which we have described as forming lateral diverticula of the heart, have so little to do with the pericardium that the lateral slits are in part cut in their base. If, therefore, these organs are vessels and not ligaments, they are arteries and not veins. I hesitate the less to pronounce in favour of the old opinion of Treviranus*, because the existence of lateral arteries of the heart is a *desideratum*—the quantity of blood issuing through the posterior orifice of the heart being evidently far inferior to that which traverses the anterior regions of that organ.

The heart and its lateral arteries are the sole arterial vessels of the abdomen. The blood is poured out by them into the interorganal lacunæ, and bathes all the organs. The heart itself is bathed by a mass of blood which travels in an opposite direction to that contained in the heart—that is to say, from behind forward. This liquid is drawn in through the lateral-orifices at each diastole of the heart. I cannot say whether this pericardiac lacuna is the cavity of a pericardium. I have never seen anything that appeared to indicate the presence of such an organ, but I may say that I have rather been led to doubt its existence. The integument of the young Spider presents several tergal arches—vague indications of a dorsal segmentation. Their number appears to be six, or perhaps seven. At each of them is a muscular ligament attached to the heart, no doubt corresponding to the muscles called the *wings of the heart* in Insects. These muscles appear to be attached, on the one hand, to the integuments, and, on the other, to the *wall of the heart itself*. There is nothing to indicate the existence of a pericardium; moreover it is a question of secondary importance to ascertain whether the blood is here contained in an interorganal lacuna or in a pericardium. The important fact (and this is beyond all dispute) is, that the heart is bathed in all parts by a mass of blood contained in a space which I shall provisionally name the *pericardiac lacuna*, without, however, attaching any importance to this denomination. A fact which is equally important to note is, that the origins of the lateral arteries to which I have given the name of *lateral diverticula* of the heart *are bathed externally by the blood* of this lacuna. Now this could not take

1836, tome vi. p. 355). See also the 'Règne Animal,' édition illustrée: Arachnides, pl. 3.

* Ueber den inneren Bau der Arachniden, 1812, p. 28.

place if the views of M. Blanchard with regard to his supposed pneumocardiac vessels and the pericardium were well founded.

It is true that there are, in some degree, pneumocardiac vessels, and even a kind of pulmonary veins. These vessels, however, have the following peculiarities:—they are very wide, they never communicate directly with the arteries or with the heart, and both their extremities open into interorganal lacunæ. I shall call them *sinuses*, desiring to indicate thereby that they incontestably possess proper walls.

I shall describe these sinuses, commencing with those whose office it is to conduct the blood to the respiratory organs, and concluding with those which convey the oxygenated blood to the heart. We have seen that the posterior region of the body presents a very large lacuna, occupying especially the pygidium and the spinners. The blood which fills this lacuna passes at the ventral part of the abdomen into two sinuses—the longitudinal sinuses of the abdomen—which convey it forward. These two sinuses are nearly parallel to each other, and their walls are of a silky whiteness when they are seen by incident light. The blood flows in them constantly from behind forwards. These two sinuses occupy the whole length of the abdomen, and unite in a median sinus at its base. In their anterior portion, however, these sinuses present a circulation exactly opposite to that just described. The blood there always travels from before backward: this is because at this part they carry the blood of the thoracic lacunæ. In reality these longitudinal sinuses of the abdomen are composed of two parts, which, anatomically, form the direct continuation the one of the other, but which nevertheless convey the blood in opposite directions. The point of junction of these two parts is the inner and posterior angle of the lung; here each of the longitudinal sinuses gives origin to a transverse process, which may be called the posterior pulmonary sinus, as it borders the posterior margin of the lung. The two currents of the longitudinal sinus flow into this transverse sinus, in which they mix together; on arriving at the outer and posterior angle of the lung, the stream of blood changes its direction, almost at a right angle, to form what may be called the lateral pulmonary sinus, which follows the outer margin of the lung. This sinus then bends towards the upper part of the abdomen to open into the pericardiac lacuna, nearly at the level of the first pair of lateral orifices. Most of the blood-globules pass from the posterior to the lateral pulmonary sinus by describing the angle that I have just described; some, however, cut this angle by gliding obliquely over the lung. This proves that the posterior and lateral pulmonary sinuses are only the margins of a large sinus in which the entire lung is immersed.

The blood-globules never penetrate between the leaflets of the respiratory organ; and, no doubt, it is the plasma of the blood that is endowed with the function of absorbing oxygen and emitting carbonic acid.

In consequence of the arrangement of sinuses which I have just described, the greater part of the blood passes through the lung before returning to the heart. This is the case with all the venous blood of the cephalothorax arriving by the anterior part of the median longitudinal sinuses; it is also the case with a great part of the blood returning from the pygidian lacuna through the posterior part of these sinuses. It is possible that the quantity of abdominal blood arriving at the lung may be still greater; in fact each longitudinal sinus of the abdomen receives, about the middle of its length, a transverse sinus, which probably brings to it a new affluent. Nevertheless I have never been able to ascertain the direction of the circulation in this sinus; it may be that it conveys non-oxygenated blood derived from the longitudinal sinus into the pericardiac lacuna. However this may be, it seems probable that a great part or even nearly the whole of the blood of the pericardiac lacuna behind the first pair of lateral orifices has not passed through the lungs. Indeed, it must not be forgotten that the blood moves from behind forwards in this lacuna. All the blood that returns from the lungs penetrates into the heart through the first pair of lateral orifices.

The longitudinal sinuses of the abdomen, in which the blood is seen in rapid motion, appear to have hitherto escaped the notice of nearly all observers. It is probable, however, that they might be demonstrated even by the scalpel in the larger species. Their position, indeed, is easily determined; they repose exactly upon the longitudinal muscular bands which Treviranus* was the first to indicate, which were subsequently described by Brandt† as *tendons*, and which recent anatomists, M. Blanchard included, have seen like their predecessors. Dugès alone seems to have had some knowledge of these sinuses. He says‡: "In the common *Epeïra* of Walckenaer the skin of the abdomen is very transparent and slightly coloured soon after a moult, and then the whole abdomen may be seen banded transversely and obliquely by very superficial vascular ramifications, starting from the whole length of the lateral and superior margins of the heart and from its posterior extremity. They are seen less distinctly in the *Epeïra diadema*. These innumerable vessels,

* *Loc. cit.* p. 45.

† Recherches sur l'Anatomie des Araignées (Ann. Sc. Nat. 2^e sér. 1840, tome xiii. p. 180.

.. ‡ *Loc. cit.* p. 359.

too delicate and too pellucid to be dissected, curve downwards and forwards towards the lungs; they become enlarged and apparently confounded together in proportion as they approach the latter, so as to constitute a lacuna parallel to the large longitudinal muscles which occupy the lower region of the abdomen. This space is transparent and filled with fluid in *Pholcus**. This description is in perfect accordance with what we have said of the *Lycosæ*, except as regards "the innumerable vessels." Dugès, however, does not appear to have seen the blood in circulation.

There was a time when M. Blanchard did not go so far as Dugès in the multiplication of the blood-vessels in the Arachnida. He said, at this period †, "What appears to be remarkable in the vascular system of *Epeïra* is the small number of ramifications presented by the arteries; for my investigations and experiments have been repeated upon a very large number of individuals, and always with success; I think, therefore, that few details can have escaped me." The opinions of the learned anatomist have become greatly modified since that time. At any rate, M. Blanchard then represented, in *Epeïra diadema*, two vessels nearly in the position of the longitudinal sinuses which we have described; but he regarded them as pneumocardiac vessels destined to convey the oxygenated blood to the posterior part of the heart. He therefore assumed that the movement of the blood took place in these vessels in a direction precisely opposite to the real direction of this movement. Far be it from me to reproach him for having been mistaken on this point; for the method of injections alone could never solve the question of the direction of the movement.

Hitherto I have only considered the abdominal circulation; but I shall now speak of that of the cephalothorax. The arterial portion of this circulation is now well known, thanks to the investigations of Dugès, and especially of M. Blanchard. The ramifications of the aorta in the *Lycosa saccata* are nearly identical with those figured by M. Blanchard in *Mygale avicularia*. This large vessel traverses the abdominal peduncle above the digestive canal, follows an ascending direction beneath the posterior dorsal region of the cephalothorax, and penetrates the stomach-ring. At this point it divides into two secondary aortas, which soon curve downwards so as to form a crook. Immediately beyond the crook, each secondary aorta spreads out like a duck's foot, and gives origin to several branches. These are, first, the ophthalmic artery, then the four pedal arteries, the artery of the deutognath, and that of the protognath. Each of

* This remark with regard to the *Pholci* is perfectly correct.

† Ann. Sc. Nat. 3^e sér. 1849, tome xii. p. 324.

the six latter, or at least five of them (the protognathic artery excepted), gives origin in its course to a branch which is directed towards the ventral region, and empties itself into one of the lacunæ which we shall shortly describe under the name of *transverse sternal lacunæ*. Lastly, the artery of the protognath gives origin to a branch directed upwards and inwards, and which discharges itself into a blood-reservoir which we denominate the *median tergal lacuna*.

These are all the vessels of the cephalothorax. M. Blanchard also describes, under the name of *posterior aorta*, a delicate median artery originating by one root from each secondary aorta, and returning backward into the abdomen. I have not succeeded in seeing this, although I will not for that reason dispute its existence. The *Lycosæ* are certainly very unfavourable for the recognition of a vessel so placed. On the other hand, M. Blanchard describes neither the sternal arteries nor the tergal branch of the artery of the protognath which I have pointed out. I must say, however, that their investigation is not free from difficulties, and that for a long time I was doubtful of their existence.

All these arterial vessels are very clearly bounded by evident walls, and all present the phenomenon of rhythmic pulsations synchronous with those of the heart. These pulsations, the observation of which is far more easy than that of the passage of the blood-corpuscles in the calibre of the vessels, greatly facilitates the study of the arterial system. The first fact that strikes the eyes of the observer, whether he examines the animal from its lower or from its dorsal surface, is the existence of two perfectly circular clear spots—one to the right, the other to the left, of the median line. These spots present a very evident alternate movement of diastole and systole; they represent the transverse section of the aortic crooks by the focal plane of the microscope. It may indeed be easily ascertained, by an alternate ascending and descending movement of the tube of the microscope, that these circles are the expression of vertical tubes in which the blood moves from above downwards.

Reserving for future consideration the circulation of the blood in the extremities, let us examine the course of the venous blood in the cephalothorax. The veins here are simple interorganal lacunæ, without appreciable walls, into which the arteries discharge themselves. On examining the cephalothorax from its ventral surface, we soon recognize a very regular and very elegant system of venous currents, situated immediately beneath the chitinous layer. These sternal currents are almost exactly rectilinear, and travel in channels existing between the muscles of the sternum. We may distinguish a median channel, a la-

cuna giving origin to ten lateral or transverse channels arranged in pairs and starting from the median channel at more and more open angles in proportion as they approach the anterior margin of the animal. At the point of junction with each lateral channel the median channel undergoes an enlargement, from the bottom of which blood-corpuscles are seen emerging from the deeper parts. These corpuscles continue their course to right and left in the lateral channels, or forward in the median one as far as the lower lip, where they also throw themselves into lateral channels. Those corpuscles only which emerge from that enlargement of the median channel corresponding to the origin of the hindmost pair of lateral channels, continue their course in great part from before backwards in the posterior part of the median channel. They then traverse the abdominal peduncle, and throw themselves into the sinus of the base of the abdomen.

The blood which passes from the median into the lateral channels reaches the sides of the cephalothorax, where it unites with the currents returning from the legs in a subcutaneous lacuna occupying the whole lateral margin of the cephalothorax. In this lacuna the blood moves from before backwards; it arrives at the abdominal peduncle, where it empties itself, with the blood of the median channel, into the sinus of the base of the abdomen.

The lateral channels of the sternum do not, however, receive blood only from the median channel; at certain distances they themselves present enlarged spaces, from the bottom of which corpuscles are seen emerging, which come from still more deeply seated regions. These corpuscles continue their course with the blood coming from the median channel.

The enlarged spaces to which I have just adverted in the median and lateral channels establish a communication between these channels and more deeply seated lacunæ. The latter exist between the muscular masses which are bounded at the surface by the channels themselves; this is so true, that the interstices of communication are in part temporary. They are sometimes seen to close whilst others open beside them. In all cases their diameter varies continually, according to the movements of the animal. These lacunæ receive their blood from the sternal arteries, which open into them without any ramification.

The cephalothorax, examined from its dorsal surface, presents a less complex venous system. The eyes are bathed posteriorly by a lacuna which receives its blood from the ophthalmic arteries and conducts it into the lacunæ of the sides of the thorax already mentioned. Besides these, a subcutaneous channel (the *median tergal channel*) conveys the blood in a direct line to the abdominal peduncle. This channel receives its blood in part

from the ophthalmic lacuna, but chiefly from deep-seated median lacunæ; it becomes enlarged momentarily at one place or another, and it is at these points that the blood-corpuscles emerge from the depths. The blood is poured out into these median lacunæ by the inner and ascending branch of the artery of the protognath.

To complete this picture of the circulation in the *Lycosæ*, it now only remains for me to describe the course of the blood in the legs. The pedal arteries and the artery of the deutognath above mentioned are easily seen penetrating into the extremities. Each artery has its distinct walls and its regular pulsations, and we may trace it readily through the coxopodite and the basipodite to the middle of the mesopodite. Beyond this point I have never succeeded in recognizing either its walls or its pulsations. At the first glance, the arterial blood in the following joints seems to move only in intermuscular lacunæ. It appears to be in immediate juxtaposition with the venous blood moving in the opposite direction, although the two currents never seem to interfere with one another. The artery, as long as it has proper walls, occupies the centre of the leg, and is bathed on all sides by the venous blood. But beyond the middle of the mesopodite the arterial current occupies the side of flexion, and the venous current that of extension.

It is soon seen that only a small part of the blood conveyed into the leg by the artery finds its way to the extremity of the limb. The greater part of the blood-corpuscles pass into the venous current without penetrating so far into the foot. Moreover a careful examination quickly shows that the passage of the blood-globules from the arterial into the venous current occurs at perfectly determinate points. These are five in number, and present themselves in the form of circular, or, rather, oval spots; when the limb is examined either on the side of flexion or extension. The first is situated close to the peripheral margin of the mesopodite; the second occupies a precisely similar position in the carpopodite; the third is placed in the propodite, but at a rather greater distance from its peripheral extremity; the fourth belongs to the first dactylopodite, but is still further removed from the peripheral margin of that joint; and the fifth is placed nearly in the middle of the second dactylopodite. These clear spots, with their outlines perfectly distinct and free, are openings in a membrane which separates the arterial from the venous current. If we pay particular attention to one of these apertures—for example, that in the propodite, at the same time noting the mode in which the arterial current behaves at this point, we see that part of the blood-corpuscles continue their course directly to pass into the dactylopodite, but that some of

them, on arriving at the level of the orifice, get into it, pass into the venous current, and return with it in a direction opposite to that which they previously followed. The same thing takes place at each of the other orifices.

These arterio-venous orifices of the legs are exactly of the diameter of the blood-corpuscles. Some of the latter even traverse them with difficulty; they are seen suddenly arrested at their passage into the aperture, which they entirely obliterate; they appear to oscillate for some time in the membranous frame that embraces them, and then, the obstacle being all at once surmounted, they pass quickly into the venous current.

It is natural to inquire what is the nature of the membrane in which the arterio-venous orifices are pierced. I have never been able to recognize in it anything more than a simple amorphous membrane—a delicate partition which divides the calibre of the leg into two parallel cavities. The arrangement here would therefore be perfectly similar to that which I have elsewhere described in the extremities of the *Læmodipoda**; in this case the pedal artery would discharge itself into the arterial cavity towards the middle of the mesopodite. There may, however, be another interpretation: the artery may penetrate to the extremity of the limb, as is usually supposed; and in this case the orifices which I have described would be pierced in the wall of this vessel. If I do not adopt this hypothesis, it is because I have never perceived either the walls or the pulsations of the arteries beyond the middle of the mesopodite. The carpopodite and the basipodite, in which the artery is distinct, do not appear to present any arterio-venous orifice.

I have examined comparatively the circulation in the legs of *Pholcus phalangioides* in nearly adult individuals. The relations of the arterial and venous currents are the same as in the *Lycosæ*. Unfortunately the transparency of these limbs, great as it is, is not sufficient to permit the recognition of the arterio-venous orifices. I can only say that in these Spiders the pedal artery appeared to me to be prolonged at least to the extremity of the mesopodite—that is to say, further than in the *Lycosæ*.

Such is the circulation of the blood in the Spiders of the genus *Lycosa*: it is essentially lacunar, as Dugès and Blanchard have correctly perceived. Recently, it is true, the latter has claimed for the Arachnida a far more complex circulatory system than he did at first. In his 'Organisation du Règne Animal' he figures especially an unexpected abundance of vascular networks in all the tissues of the Arachnida. Venous ramifications are supposed to receive the blood from these capillary nets, and to pour it into the interorganal lacunæ. I venture to affirm

* Beobachtungen, p. 101.

that these networks do not exist either as vessels or as lacunæ. Nothing can be more incorrect, for example, than the reticulations figured by M. Blanchard in the interior of the muscles, especially in the muscles of the legs. These muscles are certainly bathed by the blood of the lacunæ, but not a single blood-globule ever penetrates between the fibres of a muscle. It is possible, I readily admit, that in the adult Spiders the circulatory system may be a little more complex than in the young individuals which have not yet undergone their first change; but this increased complication certainly does not go so far as to cause the appearance of reticulations within the organs. Of this we may convince ourselves by the examination of the circulation in the legs of nearly adult *Pholci*. In these limbs it is easy to see that there exists only a single arterial current and a single venous current, without any ramification.

IV.—*Diagnoses of new Forms of Mollusca from the Vancouver District.* By PHILIP P. CARPENTER, B.A., Ph.D.

[Concluded from vol. xiv. p. 429.]

38. ?*Assiminea subrotundata*.

?*A.* testa haud parva, lævi, tenui, fusco-olivacea; anfr. nucl. ?... (decollatis); norm. v., rapide augentibus, subrotundatis; marginibus spiræ rectis, suturis valde impressis; basi rotundata, haud umbilicata; apertura rotundato-ovali, intus fuscescente; peritremate continuo; labro acuto; labio parum calloso; columella arcuata. Long. .28, long. spir. .13, lat. .2, div. 65°.

Hab. Neeah Bay; one specimen among *Lacunæ* (*Swan*).

May prove to be a large *Hydrobia*.

39. ?*Paludinella castanea*.

?*P.* testa compacta, solidiore, fusco-castanea, marginibus spiræ recerioribus; rugulosa, lineis distantibus spiralibus irregulariter insculpta; anfr. nucleosis ?... (detritis), vertice late mamillato; norm. iv., rapidius augentibus, tumidioribus, suturis satis impressis; basi regulariter excurvata, vix rimata; apertura suborbiculari, haud continua; labro acuto; labio supra parietem obsoleto, supra columellam arcuatam intus calloso; operculo, anfr. iv. haud rapide augentibus. Long. .21, long. spir. .09, lat. .17, div. 70°.

Hab. Neeah Bay; one specimen among *Lacunæ* (*Swan*).

May be an aberrant *Assiminea*.

40. *Mangelia crebricostata*.

M. testa tereti, rufo-fusca, albo zonata; anfr. nucl. ?... (decollatis); norm. v. elongatis, subrotundatis, suturis impressis; costis radi-

antibus, obtusis, subrectis, circ. xv., spiram ascendentibus; sculptura spirali? . . . (detrita); apertura pyriformi, antrorsum in canalem brevem attenuata; labro postice parum sinuato; labio conspicuo. Long. .54, long. spir. .3, lat. .2, div. 28°.

Hab. Neeah Bay; 1 specimen (*Swan*).

41. *Mangelia interfossa*.

M. testa parva, valde attenuata, rufo-fusca, marginibus spiræ parum excurvatis; anfr. nucl. ii., ut in *Chrysodomo* irregularibus, apice mamillato; norm. vi., parum excurvatis, haud tabulatis, suturis distinctis; costis radiantibus circ. xv., angustis, extantibus; costulis spiralibus circ. xv., quarum circ. v. seu vi. in spira monstrantur, angustis, supra costas transeuntibus, ad intersectiones parum nodulosas; interstitiis altis, quadratis; basi effusa; apertura subpyriformi; labro acuto, postice vix emarginato; labio tenui. Long. .38, long. spir. .22, lat. .13, div. 25°.

Hab. Neeah Bay; very rare (*Swan*).

42. ?*Mangelia tabulata*.

?*M.* testa parva, solidissima, luride rufo-fusca, marginibus spiræ excurvatis; vertice nucleoso chalcedonico (eroso); anfr. norm. v., postice rectangulatim tabulatis, suturis impressis; costis radiantibus circ. xvi., validis, obtusis, circiter basim attenuatam obsoletis; costis spiralibus in spira iii.-iv. angustis, extantibus, supra cost. rad. nodosis; interstitiis alte insculptis, subquadratis; costis circa basim circiter vii., quadratim extantibus, interstitiis a lineis incrementi vix decussatis; canali curta, aperta; labro acutiore, ad angulum posticum vix sinuato; labio tenui; columella obsolete uniplicata. Long. .45, long. spir. .26, lat. .2, div. 35°.

Hab. Neeah Bay; several worn specimens (*Swan*).

The distinct fold near the base of the pillar may require the formation of a new genus.

43. ?*Daphnella effusa*.

?*D.* testa gracillima, maxime effusa, rufo-fusca; anfr. angustis, elongatis, suturis impressis; striis spiralibus crebris a lineis incrementi decussatis ornata; labro tenuiore, postice vix sinuato. Long. .65, long. spir. .45, lat. .22, div. 30°.

Hab. Neeah Bay; one broken specimen (*Swan*).

44. *Odostomia satura*.

O. testa magna, alba, lævi, solidiore, satis elevata; anfr. nucl. ii., angustis, subplanorboideis, valde decliviter sitis, dextrorsum immersis, sinistrorsum extantibus; norm. v., tumidioribus, regulariter convexis, suturis impressis; basi rotundata, tumente, quasi umbilicata; apertura ovata; labro vix sinuato; labio tenui, ap-

presso ; plica columellari valida, subantica, parieti haud contigua, transversa. Long. .26, long. spir. .14, lat. .13, div. 40°.

Hab. Neeah Bay ; rare (*Swan*).

Var. *pupiformis* : anfr. primis valde depressis, planatis ; vertice mamillato ; anfr. ult. normali. Specimen unicum, quasi monstruosum. Long. .19, long. spir. .1, lat. .12, div. 45°.

44 b. *Odostomia* (? var.) *Gouldii*.

O. testa solida, alba, ovoidea, marginibus spiræ valde excurvatis ; vert. nucl. decliviter immerso ; anfr. norm. v., subplanatis, suturis valde impressis ; periphæria haud angulata ; basi excurvata, haud tumida ; apertura ovata, postice parum constricta ; labro solido ; labio conspicuo, rimam umbilicalem formante ; plica submediana, solida, extante, haud declivi. Long. .23, long. spir. .13, lat. .1, div. 30°.

Hab. Neeah Bay ; very rare (*Swan*).

Agrees in some respects better with the diagnosis of *O. grævida*, Gould, than do Col. Jewett's shells, from which it is presumed the species was described. These large forms appear very variable.

45. *Odostomia nuciformis*.

O. testa magna, compacta, lævi, solida, alba ; anfr. nucl. ? . . . (erosis), vertice submamillato ; anfr. norm. v., subplanatis, subelongatis ; spira brevi, marginibus valde excurvatis ; basi elongata, haud umbilicata ; apertura subovali, postice angusta ; labro solido ; labio tenui ; plica antica, solida, obtusa, transversa, parietem haud attingente. Long. .3, long. spir. .14, lat. .18, div. 70°.

Hab. Neeah Bay ; extremely rare (*Swan*).

45 b. *Odostomia* (? var.) *avellana*.

O. testa *O. nuciformi* indole simili, sed spira valde prolongata. Long. .32, long. spir. .16, lat. .16, div. 50°.

Hab. Neeah Bay ; one specimen (*Swan*).

Like a gigantic form of *O. conoidalis*.

47. *Odostomia tenuisculpta*.

O. testa ovoidea, subelevata, albida, tenui, diaphana ; anfr. nucl. subverticaliter immersis, angustis ; norm. iii., parum tumidis, suturis impressis, sulculis spiralibus latioribus haud impressis, distantibus, in spira iii., circa basim rotundatam circ. vi. subobsoletis ; apertura ovata ; plica acuta, declivi, parva, parieti contigua ; labro acuto ; labio indistincto ; columella antice parum effusa. Long. .1, long. spir. .04, lat. .06, div. 60°.

Hab. Neeah Bay ; one specimen (*Swan*).

48. *Scalaria Indianorum*.

S. testa gracili, turrita, alba; anfr. circ. x., rotundatis, parum separatis, lævibus; basi simplici, haud umbilicata; costis viii.-xv. (plerumque xii.), acutioribus, subreflexis, interdum latis, plerumque lineis irregularibus margini spiræ recto parallelis ascendentibus, rarius juxta suturam subnodosis; apertura ovata. Long. 1.05, long. spir. .8, lat. .36, div. 28°.

Hab. Neeah Bay (*Swan*).

Strung as ornaments by the Indian children. Intermediate between *S. communis* and *S. Turtonis*, and scarcely differs from "*S. Georgettina*, Kien.," Mus. Cum. no. 34, Brazil.

48 b. *Scalaria* (? *Indianorum*, var.) *tincta*,

S. ?Indianorum costis acutis, haud reflexis; anfractibus postice fusco-purpureo tinctis.

Hab. Cerros Island (*Ayres*); S. Pedro (*Cooper*).

The Lower-Californian shell may prove distinct. It is like *S. regularis*, Cpr., but without the spiral sculpture.

Subgenus *OPALIA*, H. & A. Ad. (diagn. auct.).

Scalariæ varicibus obtusis, irregularibus, parum definitis: sculptura basim versus interrupta.

Ex. in Mus. Cum.:—*O. crassicostata*, *O. crassilabrum*, *O. diadema*, *O. funiculata*, *O. crenata*, *O. granulosa*, *O. australis*, *O. bicarinata*, *O. attenuata*, Pse., *O. M'Andreae*, Fbs., sp. ined. (West Indies). Other West-coast species are *O. crenatoides* and var. *insculpta*, *O. spongiosa*, and *O. retiporosa*.

The species of this very natural group were arranged by Messrs. Adams partly under *Opalia* and partly under *Cirsotrema*.

49. *Opalia borealis*, Gld.

O. testa O. australi simillima, valde elongata; anfr. xii., planatis, suturis parum impressis; testa jun. costis validissimis viii. latis, rotundatis, peripheriam attingentibus, interdum interruptis; testa adulta sæpius obsoletis, ad peripheriam evanidis; circa basim totam usque ad peripheriam angulatam lamina spirali, planata; apertura ovali; tota superficie minutissime spiraliter striolata: operculo paucispirali, nucleo ad trientem longitudinis sito, lineis incrementi validis. Long. 1.7, long. spir. 1.3, lat. .53, div. 20°.

Hab. Puget Sound (*U. S. Expl. Exp.*); Neeah Bay and Tatoche Island (*Swan*).

This species was doubtfully indicated, not described, by Dr. Gould, in the 'E. E. Moll.' p. 207. It appears to be exactly iden-

tical with "*crassicostata*, Australia," in Brit. Mus., and is nearly related to *Ochotensis*, Midd. It must not be confounded with *Acirsa borealis*, Beck. One young specimen has the ten ribs of *O. australis*.

50. *Cerithiopsis munita*.

C. testa C. purpureæ simili, sed angustiore, marginibus spiræ fere rectis; costis spiralibus magis expressis, testa adulta minus nodulosis; basi æqualiter lirulata. Long. .34, long. spir. .24, lat. .11, div. 20°.

Hab. Neeah Bay; common (*Swan*).

51. *Cerithiopsis columna*.

C. testa majore, valde elongata, purpureo-fusca; anfr. norm. ix., planatis, suturis distinctis; seriebus iii. nodulorum spiralibus valde appressorum, creberrimorum, interstitiis parvis, altis; aliis interdum intercalantibus; lira quarta supra suturam haud valde nodulosa, liris duabus haud expressis aream suturalem circumcumeuntibus; basi planata, haud sculpta, ad peripheriam obtuse angulata; apertura quadrata. Long. .38, long. spir. 32, lat. .1, div. 10°.

Hab. Neeah Bay; several worn specimens (*Swan*): Monterey; rolled fragment of larger shell (*Cooper*).

Easily recognized, even in portions, by the "strung-fig" pattern.

55. *Cancellaria modesta*.

C. testa elata, subrufa, trichotropiformi, marginibus spiræ rectis; anfr. norm. v., rotundatis, postice subtabulatis, suturis impressis; costis spiralibus obtusis, distantibus, in spira circ. iv., circa basim prolongatam circ. vii., aliis minoribus interdum intercalantibus; interstitiis secundum incrementa, decussatis; apertura subquadrata; columella plicis duabus declivibus anticis et costulis basalibus ornata; labio nullo. Long. .68, long. spir. .34, lat. .34, div. 50°.

Hab. Neeah Bay; one specimen and fragment (*Swan*).

56. *Velutina prolongata*.

V. testa majore, subplanata, tenuiore, carnea, spira minima; anfr. iii. et dimidio, rapidissime augmentibus; vertice vix conspicuo; anfr. ult. antice valde porrecto; regione columellari incurvata; labio valido; axi haud rimata; epidermide tenui, rugis incrementi ornata, spiraliter haud striata. Long. .1, long. spir. .15, lat. .95, div. 140°.

Hab. Neeah Bay; rare (*Swan*).

V.—Descriptions of new Genera and Species of Phytophaga.

By J. S. BALY.

Fam. Chrysomelidæ.

Genus CARYSTEA.

Corpus subelongatum aut elongatum, parallelum, convexum, sæpe subcylindricum. *Caput* breve; *facie* lata, deplanata; *epistomate* brevi, transverso; *antennis* subfiliformibus; *mandibulis* parvis; *palpis* maxillaribus articulo ultimo truncato. *Thorax* transversus, elytra latitudine æquans, lateribus non incrassato-marginatis. *Elytra* parallela, apice rotundata, plus minusve regulariter punctato-striata. *Pedes* mediocres; *unguiculis* muticis.

Type, *Carystea (Australica) Waterhousei*, Baly.

The simple claws separate this genus from *Australica*; the short head, narrow parallel form, together with the broad thorax without a thickened lateral margin, divide it from *Chrysomela* proper.

Australica fulvilabris, Germ., also belongs to this genus.

Carystea inornata.

C. elongata, minus angustata, parallela, convexa, cuprea, nitida; thorace antice et ad latera capiteque crebre punctatis, illo disco lævi, fere impunctato; elytris punctato-striatis, interspatiis subcostatis.

Long. 4 lin.

Hab. Swan River. Collected by Mr. Du Bourlay.

Head closely and coarsely punctured; face broad, impressed with a longitudinal groove, which runs upwards from the epistome; antennæ black, obscure fulvous at their base. Thorax twice as broad as long, sides rounded, converging at base and apex; upper surface closely and coarsely punctured on the sides and along the anterior margin; disk smooth, only impressed with a few very remote punctures. Elytra parallel, each impressed with eleven rows of distinct punctures, which are placed irregularly in a double series on each row, the first stria short, the eleventh formed only of a single row of punctures; interspaces thickened, subcostate.

Carystea Jansoni.

C. elongata, parallela, convexa, viridi-ænea, nitida; capite antice, antennarum basi, thorace, pectore, abdominis apice pedibusque rufo-fulvis; mandibulis antennisque extrorsum nigro-fuscis; elytris confuse punctato-striatis, punctis fortiter impressis.

Long. $2\frac{1}{2}$ –3 lin.

Hab. Swan River.

Head coarsely punctured; face with a short longitudinal

groove; vertex bright metallic green; antennæ short, subfiliform. Thorax nearly three times as broad as long, sides rounded, nearly straight and parallel at their base, converging towards the apex, anterior margin nearly truncate; upper surface smooth and very remotely punctured on the disk, more deeply and closely punctured on the sides. Elytra irregularly punctate-striate, the punctures deeply impressed and arranged in irregular double longitudinal rows; beyond the middle these rows become more confused, and the punctures less deeply impressed; general surface of elytra subremotely covered with irregular transverse grooved lines. The green colour of the under surface varies greatly in extent in different individuals.

Genus AUSTRALICA, Chevr.

Australica Digglesii.

A. subelongata, convexa, nigra, nitida; capite, thorace elytrisque rufo-fulvis, ore, antennis (basi excepta) verticis plagis tribus, thoracis plaga magna discoidali a basi fere ad apicem extensa, scutello elytrorumque singulatim plagis duabus (prima infra basin posita, transversa, utrinque abbreviata, secunda infra medium, subrotundata) nigris.

Long. $3\frac{2}{3}$ lin.

Hab. Moreton Bay. Collected by Mr. Diggles.

Head short, irregularly punctured; front impressed with a longitudinal groove, which extends upwards from the epistome; on either side, extending backwards from the upper border of the eye, is a large black patch, a third (smaller and subtrigonal) being placed on the middle of the vertex: antennæ slender, slightly thickened towards their apex; four basal joints fulvous, stained with piceous above, the others black. Thorax twice as broad as long, sides parallel, slightly converging in front; surface irregularly, but not closely, punctured. Elytra each with eleven regular rows of distinctly impressed punctures, the first being short.

Genus LAMPROLINA, Baly.

Lamprolina discoidalis.

L. elongata, convexa, violaceo-ænea, nitida; antennis nigris, basi cyaneis; femoribus, abdominis limbo, capite thoraceque fulvis, illo fronte, hoc disco, fusco-æneo maculatis; elytris cupreis, violaceo micantibus.

Long. $3-3\frac{1}{2}$ lin.

Hab. Moreton Bay. Collected by Mr. Diggles.

Face with a large triangular depression, which occupies nearly the whole space between the insertion of the antennæ, and ex-

tends upwards to the vertex. Thorax nearly twice as broad as long; sides nearly parallel, rounded and slightly converging in front; upper surface smooth, nearly impunctate, either side just within the lateral margin impressed with two large deep irregular foveæ, the surface of each of which is occupied by four or five deep punctures; covering nearly the whole of the disk is a large irregular fusco-æneous patch, which (broad in front, and attached to the anterior margin) narrows behind and extends nearly to the basal border. Elytra slightly depressed transversely below the shoulders; each impressed with eleven rows of fine but distinct punctures, the first short; apex of tibiæ sometimes obscure fulvous.

Genus CHALCOLAMPRA, Blanch.

Chalcolampira marmorata.

C. elongata, convexa, pallide viridi-flava, nitida; antennis fulvo-fuscis; elytris punctato-striatis, infra basin foveolatis, piceo marmoratis. Long. 3 lin.

Hab. Moreton Bay.

Face deeply impressed between the insertion of the antennæ; eyes black; antennæ filiform, fulvo-fuscous, joints stained with piceous above. Thorax nearly twice as broad as long; sides nearly straight and parallel, slightly dilated and rounded just before their middle, slightly converging at the apex; anterior margin concave; upper surface smooth, impunctate. Elytra narrowly ovate, smooth and nitidous, regularly punctate-striate, impressed below the basilar space and also on the outer disk with five or six deep irregular foveæ; the piceous patches cover a large portion of the surface of the disk.

Genus COLAPHUS, Redtenb.

Colaphus Bowringii.

C. anguste oblongus, valde convexus, aut obscure metallico-cæruleus aut cupreus, nitidus; capite rude punctato; thorace sparsim, ad latera crebrius punctato; elytris profunde punctatis, apice sub-acuminatis.

Long. $2\frac{1}{4}$ – $2\frac{3}{4}$ lin.

Hab. Northern China.

Head coarsely punctured; epistome separated from the face by a deep, slightly curved, transverse groove; antennæ shorter than half the length of the body; basal joints obscure piceous, the rest black. Thorax rather more than one half broader than long, sides rounded and slightly converging from base to apex; disk deeply, but very sparingly, punctured, the punctures being

irregularly crowded here and there over the surface; sides more closely punctured. Scutellum large, subtriangular, its surface smooth, impunctate. Elytra scarcely broader than the base of the thorax, rather more than three times its length, sides subparallel, apex subacuminate; surface somewhat closely covered with large deep punctures; slightly depressed below the humeral callus, obsoletely crenulate; on the inner disk, a short distance from the suture, is a narrow, smooth, impunctate vitta; this is more distinct in some individuals than in others. Body beneath strongly but distantly punctured.

Most similar in form to *C. Nacierii*, but easily distinguished from that insect by the subacuminate apex of its elytra.

Genus *PLAGIODERA*, Redtenb.

Plagioderia cognata.

P. ovata, postice attenuata, valde convexa, rufo-testacea, nitida; oculis antennisque extrorsum nigris; scutello elytris cupreis, his tenuiter punctatis, margine laterali incrassato.

Long. 5 lin.

Hab. Old Calabar.

Very closely allied to *P. thoracica*, Fabr.; more attenuated posteriorly; sides of the thorax very slightly rounded, and more quickly narrowed from base to apex, the anterior angles less obtuse; scutellum narrower, cupreous, with the exception of an obscure rufous patch at its base; elytra punctured as in *P. thoracica*; humeral angles less broadly rounded, rather more prominent, sides tapering from a short distance below the shoulders to the apex.

Plagioderia Walleri.

P. rotundata, valde convexa, rufo-testacea, nitida; oculis nigris; antennis extrorsum fuscis; scutello elytris cupreis, his tenuiter punctatis, margine laterali incrassato.

Long. $3\frac{2}{3}$ lin.

Hab. Zambesi River. Collected by Mr. Waller.

Distinguished from the preceding species, as also from *P. thoracica*, by its much shorter semirotundate form; thorax resembling in shape *P. thoracica*, its sides being less obliquely converging, more regularly rounded, and the anterior angles more obtuse than in *P. cognata*; scutellum intermediate in breadth between *P. thoracica* and *P. cognata*, entirely cupreous; elytra punctured as in *P. cognata*, regularly rounded on the sides, not attenuated behind; apex broadly rounded.

Genus *NICEA*.

Corpus elongatum, valde convexum. *Caput* exsertum; *facie* per-

pendiculari; *vertice* lato, convexo; *antennis* modice robustis, corpore paullo brevioribus, filiformibus, articulo 1^{mo} incrassato, curvato, 2^{do} brevi, 3^{tio} quarto paullo brevior, 4^{to} primo longitudine æquali, 5^{to} ad 7^{mum} singulatim quarto fere æqualibus aut perparum longitudine decrescentibus, 8^{vo} ad 11^{mum} paullo brevioribus, inter se fere æqualibus; *palpis* maxillaribus articulo ultimo ovato, apice acuto; *oculis* rotundatis, modice prominulis. *Thorax* transversus, dorso transversim excavatus. *Elytra* thorace latiora, lateribus subparallelis aut apicem versus paullo ampliatis, convexa, confuse punctata. *Pedes* modice robusti; *coxis* anticis subtrigonatis, erectis, fere contiguis; *tibiis* posticis muticis; *unguiculis* bifidis. *Prosternum* angustissimum; *metasternum* antrorsum non productum.

Type, *Nicea imperialis*. New Guinea.

This genus is nearly allied to *Doryxena*, but is separated from it by the metasternum not being produced in front.

Nicea imperialis.

N. elongata, subparallela, metallico-cærulea, nitida; *antennis* obscurioribus; *elytris* ad latera infra humeros valde excavatis, ad suturam infra basin longitudinaliter sulcatis, fascia lata prope medium læte fulva.

Long. 6 lin.

Hab. Dory, New Guinea.

Nicea bella.

N. elongata, subparallela, nitida, subtus cum *antennis* nigra, supra rufo-fulva; *elytris* postice vix ampliatis, fascia lata vix pone medium posita nigro-cærulea.

Long. 5 lin.

Hab. New Guinea.

Nicea dimidiatipennis.

N. elongata, nigra, nitida; *elytris* postice paullo ampliatis, læte fulvis, dimidio postico nigro-cæruleo; *antennarum* articulo ultimo apice albo.

Long. 5 lin.

Hab. New Guinea.

Genus EUMÆA.

Corpus oblongum aut subelongatum, postice paullo ampliatum, convexum. *Caput* exsertum; *facie* perpendiculari; *vertice* lato, declivi; *antennis* gracilibus, filiformibus, ad apicem leviter attenuatis, articulo 1^{mo} curvato, a basi ad apicem incrassato, 2^{do} brevi, 3^{tio} quarto paullo brevior, 4^{to} ad 7^{mum} singulatim primum fere æquantibus, 8^{vo} ad 11^{mum} vix brevioribus, inter se fere æqualibus; *palpis* maxillaribus articulo ultimo penultimo longiore, ovato, obtuso; *oculis* prominulis, rotundatis. *Thorax* transversus, disci medio late transversim excavatus. *Elytra* thorace latiora, postice paullo ampliata, convexa, confuse punctata, disco costata. *Pedes* sat graciles; *coxis*

anticis fere contiguis, subtrigonatis, erectis; *tibiis* posticis apice muticis; *unguiculis* bifidis. *Prosternum* angustissimum.

Type, *Eumæa pulchra*, Baly.

Distinguished from the preceding genus by the slender antennæ, the costate elytra, and the different form of the sulcation of the thorax. In *Eumæa* the depression extends nearly across the surface of the disk, not quite reaching its lateral border, either side being impressed by a large deep fovea. In *Nicea* the sulcation is broader, extending entirely across the disk to the lateral border, and has its front and hinder edges much less distinctly marked.

Eumæa pulchra.

E. elongata, postice paullo ampliata, convexa, læte fulva, nitida; oculis, pedibus elytrisque nigris, his fascia lata fulva ornatis, singulatim infra basin transversim sulcatis, 5-costatis, costis duabus exterioribus valde elevatis, cæteris indistinctis; antennis fulvo-fuscis, articulis apice piceis.

Long. $4\frac{1}{2}$ lin.

Hab. New Guinea.

VI.—*Observations on Raphides and other Crystals in Plants.*

By GEORGE GULLIVER, F.R.S.

[Continued from vol. xiv. p. 252.]

Ternstræmiaceæ.—Many sphæraphides, but no raphides, in the leaves and bark of young twigs of *Camellia euryoides* and of a garden variety of *Camellia*.

Vitaceæ.—Leaves, and their modifications or appendages, of *Vitis odoratissima*, *V. apiifolia*, two species of *Ampelopsis*, and *Cissus discolor*: all abounding more or less in raphides and sphæraphides, as is the case in every plant which I have examined of this order.

Zygophyllaceæ.—The crystals in the bark of *Guaiacum officinale* are large prisms, like those of *Quillaja*, *Iris*, &c. The prisms have commonly four equal faces, and two of them are occasionally broader than the other two, as in *Fourcroya*. We have already noticed that some of the prisms are triangular; and this and the flattened square are such forms as might result from a longitudinal cleavage of the equally four-sided shafts, in one case diagonally from angle to angle, and in the other from the centre of each of the two opposite faces. But I have at present seen only imperfect evidence of such cleavage.

Melastomaceæ.—Leaves and twigs of *Melastoma*, sp.: sphæraphides plentiful, especially in the liber and mesophlœum; but no raphides.

Passifloraceæ.—No raphides, but an abundance of beautiful sphæraphides, in the petioles and leaves of two species of *Passiflora*.

Compositæ.—I have already described ('Annals,' Jan. 1863, and July 1864, p. 55) the crystals in the ovary-coat of this order. They are generally very remarkable in the suborder Cynarocephalæ; and their form may differ curiously even in two nearly allied species of one genus. Thus in *Centaurea nigra* the beautiful and numerous crystals are about $\frac{1}{1000}$ th of an inch long and $\frac{1}{6400}$ th thick, with three or four faces and angular pointed ends; while in *C. scabiosa* and *C. ragusina* the crystals are not so elongated, but are lozenge-shaped, square or cubical, and regularly about $\frac{1}{2400}$ th of an inch in diameter.

Oleaceæ.—The British plants of this order are devoid of raphides; and only a few sphæraphides were found in the leaves of *Olea latifolia*.

Orchidaceæ.—Leaves of *Goodyera repens*, *G. discolor*, *Listera ovata*, *Neottia spiralis*, *Cypripedium calceolus*, *C. spectabile*, *C. venustum*, *C. insigne*, *C. sp.*, *Zygopetalum Mackayi*, *Z. crinitum*, *Dendrobium nobile*, *Epipactis palustris*, *E. latifolia*, *Cymbidium sinense* and *C. aloifolium*: in all these, raphides are more or less abundant, but scantier in the last three than in the before-named plants of the order; plentiful in the stem, ovary, and placenta, and scanty in the sepals and petals, of *Cypripedium spectabile*; and the raphis-cells well seen through the leaf of *Neottia*. In the leaves of *C. insigne* (if I have not mistaken the plant) were also numerous larger crystal prisms, like those of *Fourcroya*.

These observations are all to the same effect as the former ones ('Annals,' March 1864). Every species which I have yet examined of this order affords raphides, while I have failed to find them at all in the few species tried for the purpose in the two orders Hydrocharidaceæ and Scitamineæ, between which the order Orchidaceæ stands in Professor Balfour's 'Manual of Botany.'

Iridaceæ.—In *Iris deflexa* the crystal prisms have commonly four equal sides, and the ends as if cut off obliquely from angle to angle or from face to face; while in *Witsenia corymbosa* the prisms are mostly truncate; and in this last plant they are much more plentiful in the pale base than in the other part of the leaf. *Trichonema columnæ* and the garden *Crocus*: crystal prisms in the leaves. *Sisyrinchium anceps*, *S. Bermudianum*, and *S. striatum*: neither crystal prisms nor raphides in the leaves. And I have failed to find such crystals, after repeated trials during several years and at various seasons, in a plant of *S. anceps* growing side by side in my garden with species of *Narcissus*, *Orni-*

thogalum, *Muscari*, and *Iris*, although in these last four plants either raphides or the larger prisms always abound.

Amaryllidaceæ.—Raphides plentiful in the leaves, scape, and ovary of *Sternbergia lutea*, and in the leaves of *Brunsvigia Josephinæ*; but very scanty in a garden hybrid *Amaryllis*, and not seen at all in a leaf of *A. Belladonna*. Leaf of *Pancratium maritimum*: raphides small, and not plentiful. *Alstræmeria*, sp.: raphides in the scape, leaf, perianth, filaments, and anthers; abounding also in the bulb, bulb-scales, and leaves of *Leucojum vernum*. Leaf of *Fourcroya gigantea*: a few true raphides and an abundance of larger crystal prisms; these last are four-sided, mostly with two faces broader than the other two, and the ends either wedge-shaped or obliquely pointed.

[To be continued.]

Edenbridge, Dec. 8, 1864.

VII.—On the *Affinities of some doubtful British Fishes.*

By THEODORE GILL*.

1. OPHIDIUM IMBERBE, Montf.

In 1811, in the ‘Memoirs of the Wernerian Society,’ Montagu† described and figured the fish identified by him with the *Ophidium imberbe*. It was “taken on the south coast of Devon,” and in “length was *about* 3 inches;” the body “ensiform;” “the dorsal fin commences immediately above the base of the pectoral, and is at first not so broad, and usually not so *erect* as the other part,” and the caudal is cuneiform and obtusely pointed. “The colour is purplish brown, disposed in minute speckles; and along the base of the anal fin are about ten small bluish-white spots, regularly placed, but scarcely discernible without a lens, possibly peculiar to younger fishes.” The rays were respectively—pectoral 11, dorsal about 74, anal 44, caudal 18 or 20. Such was the first detailed account of *Ophidium imberbe*, based on a British fish, and such the authority on which the subsequent British faunists have preserved the species in their catalogues. By Turton‡, Fleming§, Jenyns||, Yarrell¶, Gray**, &c., it has been retained in the genus *Ophidium* (§ *Fieras-*

* Communicated by the author, having been read before the Academy of Natural Sciences, Philadelphia.

† Mem. Wern. Soc. i. (1811) p. 95, pl. 4. fig. 2.

‡ Brit. Faun. (1807) p. 83.

§ Brit. An. (1828) p. 201.

|| Man. (1835) p. 281.

¶ Brit. Fishes, ii. (1841) p. 412.

** List Brit. An. Brit. Mus., Fishes, (1851) p. 51.

fer), while more recently Kaup*, Richardson†, and Günther‡ have transferred it to the genus *Gymnelis*, the first originally under the name of *Cepolophis* §. It remains to examine into the grounds for such approximations.

It is not probable that a fish whose dorsal fin arrested the attention of Montagu on account of its being so "erect" could have been a Malacopterygian; and this character, as well as the distinctness of all the rays, the development of the caudal, whose rays are longer than those of the dorsal and anal, the relations of the various parts, and even the gill-membranes inflated beneath, renders it evident that the fish in question could have been in nowise related to either *Ophidium*, *Fierasfer*, or *Gymnelis*, all of which are Malacopterygians with caudal rays shortest and not developed as a distinct fin. Its affinities are therefore to be sought for in another direction. The general form, the "erect" dorsal fin, and the number of rays agree with *Muraenoides gunnellus*. The colour is in that species sometimes simply "purplish brown," the dorsal spots becoming obsolete; and in a single specimen from England, in the Smithsonian collection, several anal spots are barely discernible||. The failure to observe the ventrals was shared with Schonevelde, Schelhammer, Linnæus, &c.; and we are more prepared for their non-observance by Montagu when we remember his peculiar views concerning the ventral fins¶. Objections may be urged against this identification—that Montagu would have recognized the *Muraenoides gunnellus*, that the proportions represented in his figure are not precisely equivalent to those of that species, and that the critical Cuvier and all succeeding naturalists have failed to notice the

* Cat. Ap. Fishes, (1856) p. 156.

† Yarrell, Brit. Fishes, (Richardson's ed.) i. p. 79 (*fide* Günther).

‡ Cat. Fishes, iv. (1862) p. 325.

§ Arch. für Nat. (1856) i. p. 97.

|| These light dots are accidental, none being developed in other specimens from England, Denmark, and the German Ocean.

¶ The reference, by Dr. Shaw, of *Vandellius lusitanicus* (= *Lepidopus caudatus*) to the thoracic order "caused the obscurity of *Vandellius lusitanicus*, as no one could have expected to have found an Apodal fish placed in that division. How that naturalist could have fallen into such an error I cannot conceive, unless he considered the pair of ventral scales as rudiments of those fins, or what is commonly attached to the base of the ventral fins of some fishes, as may be observed in many Spari." "I am aware that it has been contended that these abdominal scales are lamellated ventral fins. If so, we have yet to learn the definition of a fin in the modern revolution of science. Those who contend for the continuance of *Vandellius* of Shaw or for the *Lepidope* of Risso being continued in the Thoracic order must also constitute a new order for many fishes that have such lamellated appendages, independent of two ventral fins. But I cannot admit of a simple corneous scale, destitute of motion, being a ventral fin."—Montagu, in Mem. Wern. Soc. ii. (1818) pp. 432, 433.

identity. I shall only recall the admission that Linnæus himself, after autopsy, referred one specimen of the same species to *Blennius (gunnellus)*, and another to *Ophidion (imberbe)*, that Montagu wrote in the year 1812, and in the infancy of ichthyology, when the importance of attention to minutiae was less generally appreciated than now, and that the identification of his fish with *Murænoides gunnellus* was probably stayed by the improbability of his failure to recognize that common species.

As Dr. Günther, in the synonymy of "*Gymnelis imberbis*"*, has represented the ideas of the English naturalists, and as his work is the last authority referring to it, an analysis and reduction of that synonymy to its proper elements will form a fitting conclusion to these remarks.

1. *Murænoides*† *gunnellus*, ex L.

Ophidium imberbe, L.; Montag.; Turton, 88; Fleming, 201; Jenyns, 481; Yarrell, ed. 1. ii., ed. 2. ii. 412.

Cepolophis Montagui, Kaup.

Gymnelis imberbis, Kaup, Ap.; Rich. in Yarrell, ed. 3 (*fide* Gthr.).

2. *Carapus*‡ *acus*, Raf. ex Brün.

Ophidium imberbe, Lac. pt. (Radial formula and caudal fin of *Murænoides gunnellus*.)

* Dr. Günther remarks that *Gymnelis stigma* and *G. imberbis* "probably do not belong to this genus."

Gymnelis stigma (*Ophidium stigma*, Lay and Benn., *sic*) is probably congeneric with, and perhaps even closely related to, *G. viridis*, and it at least greatly resembles some varieties of that variable species. The poor figure and the assignment of "very small" scales to it led me, on a former occasion, to think otherwise, like Dr. Günther; but we must remember that the notes and illustrations of *Ophidium stigma* were made by an inexperienced naturalist, and that he may have been deceived as to the presence of scales. However, we may also recall that there is a great variation in squamation in a genus representing a closely related subfamily, *Lycodes*.

† The question will naturally arise, among those who contend that we should date our nomenclature from the tenth edition of the 'Systema Naturæ' (that being the first in which the binomial system is introduced), whether we should not replace the name *Murænoides*, *Centronotus*, or *Gunnellus* by *Ophidion*. Perhaps this will eventually be done, since the genus was well defined and its diagnosis only applicable to the *O. imberbe*. Others may contend that the name must be retained for the first species (*O. barbatum*), in spite of its total disagreement. The decision of this question may be suspended till the publication of the new rules of the British Association.

‡ The name *Carapus* was first connected with the *Gymnotus acus* by Rafinesque (Ind., 1819, pp. 37, 57), who only referred to that species, although he doubtless intended his genus to correspond with Lacépède's anonymous second subgenus of *Gymnotus*, which included *G. carapus*, L., *G. acus*, L. (= *Fierasfer acus*, Kaup) and *G. rostratus*, L. (= *Rhamphichthys rostratus*, M., T.). A strict adherence to the laws will, however, necessitate the retention of the name for the only species mentioned, *C. acus*.

3. *Muræna** *Anguilla*, L. (or allied sp.).

"Beardless *Ophidium*," Pennant, Brit. Zool. iii. 398; App. tab. 33.

2. "TRICHIURUS LEPTURUS."

The question which we shall next consider relates to the specimens identified by Mr. James Hoy† with the *Trichiurus lepturus* of Linnæus.

In the 'Transactions of the Linnæan Society,' Mr. Hoy has published an account of two fishes stranded, at considerable intervals of time, "upon the shore of the Moray Frith, near the fishing village of Port Gordon." The first specimen was found "on the 2nd of November, 1810, after a high wind from the north;" "its head was much broken;" "the extremity of the upper jaw, or upper part of the mouth, was entire; upon *either side of which was an operculum*;" "the body, from the gills to the point of the tail, was 3 feet 2 inches long; its greatest breadth $6\frac{1}{4}$ inches, and its greatest thickness only an inch;" "both sides of the fish were wholly white, without a spot upon them;" "the dorsal fin was the only part of a different colour, being a blackish green; this ran all the way back from the gills to the tail;" "the tail ended in a point, consisting of three or four soft spines or bristles of different lengths, not exceeding 2 inches. The body was nearly of the same breadth for one half of its length, and then its breadth diminished gradually till within 3 inches of the tail, when the diminution became more quick. The lateral line was straight, and strongly marked along the middle of the two sides."

The second specimen was obtained on the 12th of November 1812; "its head had been broken off, and was quite gone; a small bit of the gills only remained, about the upper part of the throat, from whence to the extremity of the tail its length was 12 feet 9 inches; its breadth, $11\frac{1}{4}$ inches, was nearly equal for the first six feet in length from the gills, diminishing gradually

* Bleeker is doubtless correct in retaining the name *Muræna* for the *M. Anguilla*. The name was restricted by Bloch, who first subdivided the genus, to the type represented by that species; and the *M. Anguilla* was evidently the one on which Artedi and Linnæus based their diagnoses. Repugnant as must be such perversions of names, consideration for the uniformity of nomenclature, which may best be attained by strict adherence to the laws, seems to require assent to them. The genus *Anguilla* is generally attributed to Thunberg; but a search instituted among his various memoirs has failed to reveal any mention of it, and it is to be remarked that no naturalist has referred to any precise work. Professor Agassiz, indeed, refers to "*Anguilla*, Thunb., Nuov. Mem. Stockh. 179—," but no such generic name is to be found in the series referred to under that title.

† Trans. Linn. Soc. xi. p. 210.

from thence to the tail, which *ended in a blunt point*, without any of those kind of bristles which projected from the tail of the one found formerly; its greatest thickness was $2\frac{1}{2}$ inches, the distance from the gills to the anus 46 inches. The dorsal fin extended from the head to the tail," &c. "There were no ventral nor anal fins; but the thin *edge of the belly was closely muricated with small hard points*, which, although scarcely visible through the skin, were very plainly felt all along it. Both *sides of the fish were white, with four longitudinal bars of a darker colour*; the one *immediately below the dorsal fin* was about 2 inches broad, each of the other three about $\frac{3}{4}$ inch. *The side line straight along the middle.*"

On the authority of these specimens, the *Trichiurus lepturus* was admitted by the British faunists into the catalogues of their fishes.

Dr. Fleming* considered that the two specimens belonged to different species. "The differences in the position of the vent, the structure of the tail, and the condition of the edge of the belly, seem too great to justify the inference of their being only varieties. The latter fish appears identical with the *Lepturus* of Artedi, and consequently of Linnæus."

Subsequently Dr. Fleming† considered that "the position assigned to the vent, the absence of ventral fins, and the white colour of the sides (of Hoy's first specimen), all accord with the Dealfish (*Trachipterus*). The colour of the dorsal fin, however, which was of a blackish green, seems to oppose this view, though the dead state of the fish may probably serve to explain this difference, if duly considered."

Mr. Jenyns‡ was inclined to adopt Dr. Fleming's opinion—"that the first specimen of Hoy was a distinct species, if not belonging to a different genus. There can be no doubt that the one described above (Hoy's second specimen) was a true *Trichiurus*, and probably *T. Lepturus* of Linnæus and other authors; but as the description is rather imperfect, and the species of this genus ill determined, it is impossible to speak with certainty on this last point."

Yarrell§ especially alluded to the median lateral line and lateral bands, and remarked that "it is evident that more information on the subject is required; the result of it may be the establishment of Mr. Hoy's second fish as a new species of *Trichiurus*, and of his first fish (which is evidently distinct from the second) as the type of a new genus, if, as Dr. Fleming has

* Brit. An. (1828) p. 204.

† Loudon's Mag. Nat. Hist. iv. (1831) p. 219.

‡ Manual, (1835) p. 872.

§ Brit. Fishes, i. (1841) p. 204 (207).

suggested, it was not a mutilated example of the Dealfish of the Orcadians, *Gymnetrus arcticus*."

With enlarged opportunities for arriving at a possible decision concerning at least the second specimen, I proceed to institute inquiries into the nature of these materials. The form and approximately the proportions noticed by Hoy, the "operculum on each side" of the mouth, simulated by the supramaxillars, the soft dorsal rays, the bristles at the end of the tail, and the strongly marked straight lateral line appear to indicate, as Fleming has suggested, that Hoy had before him in his first specimen a much injured example of *Trachypterus* with most of its fins destroyed; and it is probable that a hole, caused by the caducous ventral fins, might have been mistaken for the anus*. This may seem very remarkable; but it is evident that Mr. Hoy has not the slightest claim to scientific consideration, and the hole so created in *Trachypterus* would correspond in space to the "anus" discovered by that gentleman. A thoracic anus is incompatible with the structure of the Trachypteroids or any related forms. The "blackish-green" colour of the portion of the dorsal remaining might have been due to discoloration; and we need not be much astonished that the lateral dorsal spots were overlooked in such a specimen.

The second of Hoy's specimens evidently belonged to an entirely different type. The form and "closely muricated" belly indicate that it was related to the family of Lepturoids or Trichiuroids; but the "blunt point" in which the tail terminates, as well as the median lateral line, forbid us, on morphological grounds alone, referring it to *Trichiurus lepturus*. It might be supposed to have been a specimen of *Lepidopus caudatus*, were it not for the colour; but that, sustained by the superior height, forbids us to refer it to that species. What, then, can it have been?

In the summer of 1863, I received from the learned Cuban naturalist, Prof. Poey, of the University of Havanna, a fish, concerning whose systematic position he was unable to satisfy himself. This fish was found to resemble *Lepidopus caudatus* in all essential characters except the remarkable form of the head, which was exceedingly compressed, trenchant and obliquely decurved above, with the forehead elevated above the eyes, and

* This same mistake, indeed, was made in the communication by Dr. Duguid to Dr. Fleming concerning the same fish (see Loudon's Mag. iv. (1831) pp. 215, 216); and Dr. Fleming himself, so far from correcting the error, alluded to the similarity of the so-called vent as evidence of the pertinence of Hoy's fish to the same species (*op. cit.* iv. 219). By a somewhat singular coincidence, the same error in identification of *Trachypterus* with *Trichiurus lepturus* was made by Olafsen (Voyage to Iceland, p. 592).

the chin obtuse. Notwithstanding such characters, its affinity to *Lepidotus* was evidently so great, the form, structure of the fins, especially the anomalous form of the pectorals, and the development of the opercular bones coinciding, that I felt compelled to retain it in the same subfamily, in contradistinction to one containing *Trichiurus* (= *Lepturus*, Art.) and *Eupleurogrammus**. The colour arrested my attention, there being six or seven narrow bands, the lateral line running through the fourth; the interval between the two dorsal bands was more indistinct, and the two might readily be confounded; the width of the two would equal about a sixth of the height, while the width of the single ones was contained about fifteen or sixteen times in the height. The two lower bands were more indistinct. I was therefore at once reminded of the *Trichiurus lepturus* of Hoy; and the similar development of the bars, as well as the approximation in proportions, compel me to believe that Hoy's second specimen is in reality a species of the genus *Evoxy-metopon*, if not indeed identical with the Cuban fish itself (*E. tæniatus*, Poey). The greatest height of the latter, at the scapular region, is contained scarcely more than twelve times ($12\frac{1}{2}$) in the extreme length, while a short distance behind, and for a considerable distance, it is contained from thirteen and a half to fourteen times. The head is contained eight times and a half, and the caudal, at its longest rays, twenty-nine times and a half in the same. The anus is midway between the snout and the root of the caudal. In this last respect it disagrees with the specimen signalized by Hoy, according to whom the anus was very considerably within the limits of the first third of the length ($46:153+\chi$). Such a position is extremely improbable in a representative of the subfamily of Lepidopodinae, to which the specimen doubtless belongs. The true anus, on account of its small size, was probably overlooked, and a rupture of the skin mistaken for it. May we not hope that some British naturalist will soon release us from our doubts, and verify the systematic position of Hoy's fish?

3. POLYPROSOPUS, Couch.

Having provisionally adopted the generic name *Polyprosopus*, proposed by Couch in the 'Analytical Synopsis of the Order of Squali,' remarking at the same time that the genus was "not yet well established," it seems advisable now to express my con-

* Gill, "Synopsis of the Family of Lepturoids, and Description of a Remarkable New Generic Type," in 'Proc. Ac. Nat. Sc. Philadelphia,' 1863, p. 224, &c. In this article I have suggested the relation of Hoy's fish and *Evoxy-metopon tæniatus*.

viction that it belongs to the genus *Cetorhinus* or *Selache*, and that the differences observed are probably due to distortion or defective observation. I have already stated that "the absence of caudal carinæ or spiracles is quite improbable;" and certainly no ichthyologist could believe in the absence of the anal fin in such a type.

I may finally be permitted to add, in anticipation of a more extended memoir, some remarks on the Lemniscates of Richardson, and more especially the *Leptocephalus Morrisii*, Gm. The recent exposition of the character of such fishes by Professor V. Carus* will excuse this anticipation. I am happy to be able to express my unqualified belief in the conclusion as to their being simply larval forms, which that learned naturalist has enunciated. As long as the known hyaline fishes conformed to a single type, naturalists might be excused for regarding them as fully developed forms; but the doubt this group was first subjected to by the failure of Kölliker† to find organs of generation, was increased by the addition (by Kaup) of the genus *Esunculus*‡, and subsequently of *Stomiasunculus*§. Carus was therefore, I think, fully justified in his "conclusion that all these fishes are nothing but larval forms of others." But he was not so happy in looking for the adults "among the Ophidians or other compressed forms" (*Cepola*, and so on||). I am almost certain that the typical *Leptocephali*, at least, are the young of Congers, and that *Leptocephalus Morrisii* is the young of *Conger vulgaris*. I am aware, indeed, that Yarrell¶ has discovered that small Congers, "about the size (length?) of a man's finger, are found among the rocks, close to land, during the summer." But he immediately afterwards adds that "the small eels which ascend the Severn in such numbers in the spring, and were considered by Willughby and Pennant as the young of the Conger, are in reality the young of freshwater eels." May we not go a step further, and ask that it may be *demonstrated* that those "found among rocks close to land" are Congers, and not eels which have not yet commenced ascending the rivers?

The *Hyopropurus Messinensis*** appears likewise to be merely the

* On the Leptocephalidæ, in Rep. Brit. Ass. 1861, p. 125.

† Zeitschrift für Wiss. Zool. iv. p. 360.

‡ Apodal Fishes, (1856) p. 143, fig. 3.

§ Ann. & Mag. Nat. Hist. ser. 3. vol. vi. (1860) p. 270.

|| See the remarks of Dr. Peters on this question in the following article.—ED. ANNALS.

¶ Brit. Fishes, ii. (1841) p. 404.

** Kölliker, Verh. d. Phys. Med. Gesellsch. in Würzburg, iv. p. 101.

larval form of the Congroid *Nettastoma melanura* *. The resemblance between those two forms will be readily appreciated by reference to Dr. Kaup's figures of the two. Perhaps the affinities of those *Leptocephali* with an expanded caudal are to be sought for elsewhere. As to *Esunculus Costai*, it resembles the young of a Clupeoid; but the high insertion of the pectoral fins, if existent in nature, forbids for the present its positive identification with such. *Stomiasunculus* resembles, in general features, a less advanced larval Clupeoid, about three days old †, in which the ventral fins have not yet appeared. Suspicion, however, may be entertained that it may perhaps be the young of some other type (possibly Stomiadoids), on account of the backward position of the dorsal fin. I have myself, in company with a friend, seen the young of Clupeoids, which would have either been referred to *Esunculus* or considered as the type of a closely allied new genus, on account of the inferior insertion of the pectoral fins; and so transparent were they, that their eyes alone indicated their position in the water. Although entertaining no doubts concerning the larval nature of *Esunculus* and *Stomiasunculus*, I only venture to suggest the possible relations with much reserve. As to *Porobronchus*, Kaup ‡, it is, perhaps, related to *Fierasfer*; but the character of the first elongated dorsal ray requires to be known before a decision can be arrived at.

VIII.—*Description of a new Species of Leptocephalus.*
By Professor PETERS §.

Leptocephalus (Diaphanichthys) brevicaudus, Peters.

Body very much compressed; profile of the ventral margin convex, of the back nearly straight. Snout very acute, convex before the eye, a little shorter than the diameter of the eye; mouth cleft as far as beneath the middle of the eye, armed on each side, both above and below, with eight straight acute teeth, behind which, in the upper jaw, are some smaller acute teeth. The posterior nasal apertures are situated on the muzzle, rather nearer to the eyes than to the apex. The eyes are placed in the middle of the head. Branchial clefts very narrow. *No pectoral, dorsal, or anal fins*, the extremity of the body only being surrounded by the caudal fin, which extends above and below for

* Raf. Caratteri, &c. (1810) p. 66, tav. 16. f. 1.

† See Sundeval, "Om Fiskyngels Utveckling," in Kongl. Vet. Akad. Hand. i. (1855) tab. 4. fig. 6.

‡ Ann. & Mag. Nat. Hist. ser. 3. vi. (1860) p. 272.

§ Translated by W. S. Dallas, F.L.S., from the 'Monatsber. Berl. Akad. der Wiss.' June 1864, p. 399.

about $1\frac{1}{2}$ millim. In the middle of the body, its lower half is fully one-third deeper than the upper half. The colourless body exhibits along the dorsal ridge, as also on each side near the intestine, a series of black points, and beneath the chorda five oblique lines of the same colour, corresponding to the commencement of the ventral portions of the muscles.

Total length, 0·088 metre; head, 0·0035; from the tip of the muzzle to the posterior margin of the eye, 0·002; from the anus to the extremity of the tail (without the fin), 0·0033; depth of the middle of the body, 0·013.

Younger specimens, 0·060 metre in length and 0·007 [in depth] present precisely the same structure and proportions, which would furnish a sufficient proof, if such were wanted, that the *Leptocephali* are not mere larval forms of *Cepola* or other Ribbon-fishes. We have had the opportunity of seeing quite young specimens of *Cepola* and other Ribbon-fishes, and have always been able to recognize their genus, notwithstanding the well-known peculiarities of the young state.

Dr. F. Jagor, to whom we are indebted for this beautiful species, took eight specimens of it, of various sizes, in the open sea between Maybate and Luzon.

IX.—On *Plesiosaurus macropterus*, a new Species from the Lias of Whitby. By HARRY SEELEY, F.G.S., Woodwardian Museum, Cambridge.

ONE of the ornaments of the Woodwardian Museum is a grand Plesiosaur, beautifully displaying the general relations of the bones. It was obtained in 1842 by the energy of the venerable Professor of Anatomy, who, being on the spot when it was found, secured it for the University, when it was purchased by subscription, and confided to the care of the Woodwardian Professor.

The reptile rests nearly flat on the ventral side, in a natural extended posture, the tail only being two or three times bent. But the same hard concretionary limestone which preserves the relations of the bones so well, invests much of the vertebral bodies, so that their relative proportions in form and size are partly obscured.

Hitherto there have been but six species of *Plesiosaurus* described from entire specimens; and with those chiefly our new one will be compared in this brief notice.

The chief characters of the several species, as stated by Professors Owen and Huxley, Mr. Baily and Dr. Carte, are the following:—

1. *P. Cramptoni*, Baily & Carte.

Head one-sixth of skeleton and five-eighths of neck. Vertebrae: 27 cervical, 30 dorsal, caudal 34+. Length 22 feet 5 inches.

2. *P. macrocephalus*, Ow.

Neck equal to two heads. Vertebrae: 29 cervical, 20 dorsal, 2 sacral.

3. *P. brachycephalus*, Ow.

Head one-eighth of skeleton. Vertebrae 75: 28 cervical. Length $10\frac{1}{2}$ feet.

4. *P. Hawkinsi*, Ow.

Head one-tenth of skeleton. Neck equal to four heads. Tail equal to two and a half heads. Vertebrae 90 to 100: 31 cervical, 23 dorsal, 2 sacral, 35 caudal. Length $7\frac{1}{2}$ feet.

5. *P. Etheridgii*, Huxley.

Head one-twelfth of skeleton. Four lengths of skull equal to anterior 28 cervical vertebrae. Vertebrae 90: 30 cervical, 23 dorsal. Length $7\frac{1}{2}$ feet.

6. *P. dolichodeirus*, Conbr.

Head one-thirteenth. Neck equal to four lengths of head. Vertebrae: 35 cervical, 27 dorsal, 2 sacral, 26 caudal. Length 10 feet.

But if our species is compared with these, it ranges itself at the opposite end of the series to *P. Cramptoni*, having relatively the longest neck and smallest head, as may be here shown.

7. *P. macropterus*.

Head one-twentieth of skeleton, and one-eighth of the neck. Vertebrae: cervical 39, dorsal 24, caudal 28. Length 15 feet 2 inches.

I have also satisfied myself that our species is quite distinct from those which have been made from a few bones.

The orbits, nares, &c. are not to be distinguished; for the skull has been compressed: it is oblong, tapering in a parabola to the front. The teeth are slender, finely striated, curved, and an inch long: they appear to be most numerous in the anterior part of the jaw. The total length of the skull is 9 inches. From the parietal crest to the tip of the premaxillaries is 6 inches. The width of the skull is $4\frac{1}{2}$ inches.

The rami of the lower jaw are massive, $9\frac{1}{2}$ inches long, and $1\frac{1}{4}$ inch deep, and are united by symphysis at their anterior

ends. The breadth of the lower jaw across the condyles of the quadrate bone is $3\frac{1}{2}$ inches.

The length of the cervical part of the vertebral column is 5 feet 10 inches. Its anterior portion is much obscured by the investing matter and a layer of black varnish, which horribly disfigures the whole specimen. Hence the number of cervical vertebræ is not quite clear, though they are not fewer than 39. Near the dorsals they are 2 inches long, wide, with the flattened sides converging above, and only slightly compressed along the whole length till near the articular surfaces, which have sharp margins.

The length of the dorsal and lumbar part of the vertebral column is 4 feet 5 inches, and it contains twenty-four vertebræ. They have large, high, flattened neural spines, which almost touch each other, and large rounded parapophyses separated by interspaces never wider than their own diameter, and often only half of it.

The large rounded ribs in the middle of the back appear to be about 13 or 14 inches long; they are moderately curved, and embrace a width of 17 inches.

There is one vertebra certainly sacral (there may be two). Its whole side seems modified for an articulation. It is 2 inches long.

The tail is 4 feet long, and contains 28 vertebræ, remarkable for very long parapophyses.

Thus the total number of vertebræ is

$$39 + 24 + 1 + 28 = 92,$$

and the total length is

$$9 \text{ in.} + 5 \text{ ft. } 10 \text{ in.} + 4 \text{ ft. } 5 \text{ in.} + 2 \text{ in.} + 4 \text{ ft.} = 15 \text{ ft. } 2 \text{ in.}$$

The pectoral bones are crushed and hidden. The pubes and ischia are obscured in the dislocation of the pelvic region; but the iliac bones are well seen: they are $6\frac{1}{2}$ inches long, expanded and compressed spatulously behind; thick, rounded, and massive at the femoral end, which has a diameter of $2\frac{1}{2}$ inches.

The limbs are very large, and the hinder ones slightly the longer—their total length being, fore limb 3 feet $6\frac{1}{2}$ inches, hind limb 3 feet $10\frac{1}{2}$ inches.

The humerus is flattened, with the distal three-fourths of the anterior border convex, and the proximal three-fourths of the posterior border deeply cupped, the remaining distal part being truncated. It measures, in length, 12 inches; in breadth, at the radial end 9 inches, at the proximal end 4 inches; while the least breadth of the shaft is $2\frac{1}{2}$ inches.

The radius and ulna are both flattened bones; the ulna is slightly reniform, while the radius is constricted below the

middle. The length of the radius is 6 inches; its breadth at both the proximal and distal ends is $4\frac{1}{2}$ inches, the least diameter being 3 inches.

The ulna is 6 inches long and 4 inches wide. The greatest interspace between it and the radius is $1\frac{1}{2}$ inch, while both above and below they touch.

The length of the carpals is $4\frac{1}{2}$ inches: there are three in each row.

The length of the metacarpals and phalanges is 20 inches. There are five rows, and nine bones in each row.

The femur is a smaller bone than the humerus, though larger at the proximal end, which has a great trochanter. Its anterior border is nearly straight, and the posterior border is much less cupped than in the other limb. It is at least 11 inches long, $7\frac{1}{2}$ inches broad at the tibial end, while the proximal end measures in breadth $3\frac{1}{2}$ inches.

The tibia is 5 inches long, and the fibula rather less. At the proximal end the tibia is 4 inches broad; but the fibula is $4\frac{1}{2}$ inches broad: like the ulna, it is reniform.

The length of the tarsals is 4 inches; the length of the metatarsals and phalanges 25 inches; there are nine or ten in each row.

Thus this species, in the small size of the head, and the small proportion it bears to the length of the limbs, of the neck, and of the skeleton, is as well distinguished as by the number of vertebræ in the different regions of the body. It has four more cervicals than *P. dolichodeirus*, but three fewer vertebræ in the back. There are eight more cervicals than in *P. Hawkinsi*, and one more dorsal; one sacral, instead of two; and but twenty-eight caudal vertebræ, instead of thirty-five*.

All *Plesiosaur* vertebræ have epiphyses which are relatively

* In the Museum of the Yorkshire Philosophical Society is a *Plesiosaur* with the MS. name *P. homalospondylus*. Its parapophyses begin to get long, and support enormous ribs, at the 40th vertebra, but do not appear to be entirely supported on the neurapophyses till the 44th. The lower cervicals have two articulations for ribs, and are very elongated, some measuring more than 3 inches in length. The lower jaw, which has lost the articular part, measures $9\frac{1}{2}$ inches long. The total length of the specimen is 17 feet 6 inches. Therefore its formula appears to be—

P. homalospondylus.

Head about one-twentieth of skeleton, and one-ninth of the neck. Vertebræ: cervicals 44?, dorsals 16?, caudals 28. Though nearly resembling our species, and belonging, no doubt, to the same genus, it is readily distinguished. The vertebræ have their margins rounded, and not sharp. The humerus, which measures 12 inches long and 8 inches broad, has the anterior side singularly straight. The femur, which is $12\frac{1}{2}$ inches long and $7\frac{1}{2}$ broad, has the whole anterior border concave.

thick, though generally thickest in the middle and thinning away to the periphery—sometimes dying away before they reach it, and sometimes extending beyond it. They are generally united to the body of the vertebræ.

Nothing in osteology is more curious than the condition of epiphyses in the long bones of Plesiosaurs; for here they are so enormously large as to form nearly the whole of the bone, the shaft being reduced to a mere girdle encircling the ends of the epiphyses. Young specimens of humerus or femur, with the shaft 2 or 3 inches long, have generally lost their epiphyses; and in one beautiful specimen from the Kimmeridge Clay of Cottenham, presented to the University by the Rev. S. Banks, a shaft nearly *three inches in diameter* has lost both epiphyses. It is quite tubular, smooth in the central part, which is perforated for the enormous arteries, and only shows signs of attachment at its thin ends, where the inner surface is rugged. Often, in the Greensand specimens, the epiphysis of the proximal end comes out. The shaft varies much in proportion, with the species.

X.—On the Systematic Position of the Strepsiptera.

By Professor SCHAUM*.

THE family of the *Strepsiptera* or *Stylopidae*, so remarkable in their mode of development, was first regarded as a group of Coleoptera by Burmeister (Handb. der Naturgesch., 1837), and placed by him in the immediate vicinity of the Rhipiphoridous genus *Symbius*, Sundev. (Isis, 1831, tab. 8) = *Rhipidius*, Thunb., which is parasitic upon *Blattæ*. This notion has since been adopted by Newman, Schiödde, and other entomologists, and most recently by Lacordaire, who, in the fifth volume of his 'Genera des Coléoptères,' treats the *Stylopidae* as a family of Beetles standing in immediate contact with the *Rhipiphoridae*, and in connexion therewith cites some of the reasons adduced by me in favour of this view, and in opposition to the objections raised against it.

Leconte also, in his recently published work, the 'Classification of the Coleoptera of North America,' has placed the *Stylopidae* next the *Rhipiphoridae*, in consideration of their organization and development. In the "Report on the Progress of Entomology in the year 1861" (Wiegmann's Archiv, xxviii. p. 328), Dr. Gerstäcker makes the following remarks in con-

* Translated by W. S. Dallas, F.L.S., from Wiegmann's 'Archiv,' 1864, p. 145.

nexion with this:—"What characters has a Strepsipteron in common with a Beetle? *Not one*. What are the agreements in their mode of life? The Strepsiptera live parasitically upon Hymenoptera; the larvæ of the Meloidæ feed upon honey: the two *consequently have nothing in common* in their development. In elementary books least of all should absurdities be passed off as good coin." In his Report Dr. Gerstäcker places the Strepsiptera with the Neuroptera with perfect metamorphosis; and in an elementary book, a recently published 'Handbuch der Zoologie' (p. 78), he himself refers them to the Neuroptera as the third tribe.

Without taking any further notice of the tone which the reporter thinks proper to adopt with regard to an opinion entertained by distinguished entomologists (such as Burmeister and Lacordaire), I hope, by a simple enunciation of the facts upon which the decision of the question depends, to enable every zoologist who may take an interest in the matter to form an independent judgment upon the systematic position of the Strepsiptera.

The Strepsiptera undergo a complete metamorphosis; and the males possess buccal organs (mandibles, palpi) which are certainly rudimentary, because the imagines live only for a few hours, but which are to be referred to the mandibulate type. In both these particulars the Strepsiptera agree equally well with the Coleoptera and with the Neuroptera.

In the above-mentioned 'Handbook of Zoology' the characters of the Neuroptera and Coleoptera are stated in the following words:—

Neuroptera (p. 68): "with complete metamorphosis, biting oral organs, free prothorax, and membranous fore and hind wings."

Coleoptera (p. 80): "with complete metamorphosis, biting oral organs, free, strongly developed prothorax, and hard horny fore wings (wing-cases)."

The sole distinction between the two orders is therefore, according to this Handbook, that the Neuroptera have membranous and the Coleoptera hard horny anterior wings; for the "free, strongly developed prothorax" of the Coleoptera cannot be regarded as the opposite of the merely free prothorax of the Neuroptera, among which such genera as *Corydalis* and *Mantispa* possess a much more strongly developed prothorax than many Coleopterous genera.

A further physiological distinction between the two orders, which is indeed connected with the membranous or horny nature of the fore wings, but at the same time presupposes a totally different musculature of the thorax, consists in the fact that the

Neuroptera fly with both pairs of wings, the Coleoptera only with the hinder ones.

The placing of the Strepsiptera with either the Coleoptera or the Neuroptera therefore depends, *in the first place*, upon the questions whether their anterior wings are membranous or horny, and whether both pairs of wings, or only the posterior pair, are used in flight. Of the prothorax, which is very rudimentary in the Strepsiptera, we may for a time take no notice, as, according to the above diagnoses, it is free in both the Neuroptera and Coleoptera.

According to page 78 of the Handbook, the fore wings of the Strepsiptera are "in the form of small stumps, rolled up at the apex." Are these membranous fore wings? Are these organs that take part in flight? Any comparison of these stumps with the membranous *veined* anterior wings of the Neuroptera is quite untenable, because in the orders with two pairs of membranous wings, both assisting in flight (Neuroptera, Hymenoptera, Lepidoptera), the anterior wings are never aborted alone, and, from the preponderant importance of those organs for the purpose of flight, cannot be aborted. In these orders both pairs of wings are sometimes aborted (as in *Boreus* among the Neuroptera), but the function of flight is never transferred entirely to the posterior wings.

But the anterior wings of the Strepsiptera, during the life of these animals, are by no means twisted stumps; and this is expressly insisted on by Smith, who has had the opportunity of observing them alive*: from the delicacy of the insect, they change their form very quickly after death; and their condition in dried specimens consequently enables us to form no opinion of their nature during life. The passage in Smith's paper (Trans. Ent. Soc. ser. 2, vol. iv. p. 116) is as follows:—

"The texture of all parts of the body of a male *Stylops* is of so delicate a nature that within two hours after death the entire appearance of the insect is changed, bearing no more resemblance to the living creature than a shrivelled mummy does to the once graceful Egyptian; the remarkable *lateral appendages of the thorax*" (elsewhere denominated *pseudelytra*), "which in life were *rounded on one side and flattened on the other*, become entirely changed in form."

In Smith's figure, drawn from the life, the anterior wing of *Stylops* shows the most unmistakeable analogy with the stunted, widely separated, and gaping elytra of the Coleopterous genera *Symbius* and *Atractocerus* (to which even Westwood called at-

* The extraordinary rarity of the Strepsiptera, and the shortness of their life, which extends only to a few hours, have allowed them to be observed in the living state by only a few entomologists.

tention [Introd. vol. ii. p. 293], although he had only examined dried specimens); it is coriaceous and destitute of veins, like an elytron. Such a structure of the anterior wings stands in the most complete opposition to the most essential character of the Neuroptera.

With this structure of the fore wings, the hinder pair of course constitute the sole organs of flight in the Strepsiptera. In the above-mentioned 'Handbook' (p. 79), the agreement in the radiate venation of the posterior wings is indeed adduced as an argument in favour of the position of the Strepsiptera among the Neuroptera, "only that in the Strepsiptera this occurs still more decidedly and clearly." Neither in their development nor in their venation, however, have the posterior wings any analogue among the Neuroptera; but they find one in the Coleopterous genus *Atractocerus*, as indeed has already been correctly indicated by Westwood in his classical work, the 'Introduction to the modern Classification of Insects' (which is still the only good introduction to the study of special entomology). The radiate arrangement of the venation is indeed characteristic of the posterior wings of the Coleoptera in a far higher degree than of those of the Neuroptera.

Before we pass to the development of the Strepsiptera, we have still to glance at the arguments that have been adduced in favour of their position with the Neuroptera, and the objections which have been raised against their union with the Coleoptera. In the above-mentioned 'Handbook of Zoology' (p. 79) we find "the family (Strepsiptera) by its essential characters" (perhaps the nature of the anterior wings) "naturally approaches the Neuroptera, and among these especially the Phryganidæ. With the latter it agrees in the structure of the prothorax, which never occurs among the Coleoptera, in the elongated, free anterior and middle coxæ, the rudimentary buccal organs, of which the maxillæ are amalgamated with the labium, as also in the radiate venation of the posterior wings, only that the latter is more decidedly and clearly marked; this relationship is further proved by the branchiiform respiratory organs discovered by Newport on the abdominal segments of the larvæ of Strepsiptera."

The Strepsiptera are therefore appended to the Neuroptera, not because they agree with that order in their chief character, the nature of the fore wings (which is rather in complete opposition to the above-cited diagnosis of the Neuroptera), but because they are supposed to agree in some secondary characters with a family (Phryganidæ) which is referred to the Neuroptera. Of these secondary characters, the radiate arrangement of the venation of the posterior wings has already been indicated as characteristic of the Coleoptera. Branchiiform respiratory organs

have been observed on the larvæ of the Strepsiptera neither by Klug nor by Von Siebold (see Wiegmann's 'Archiv,' 1843, p. 154); and even Newport has *not* demonstrated them, but rather expresses himself very cautiously on the subject. He says (Trans. Linn. Soc. xx. p. 345), "In the larvæ there *appeared* to be eight pairs of bag-shaped dark bodies at the sides of the abdominal segments, situated in the place of the respiratory organs of other insects. From their darkened appearance and from their resemblance to branchial sacs, they *may perhaps* be regarded as imperfect respiratory organs of the nature of branchiæ." And such a conjectural statement as this, which is not even remotely put forward as a fact, and appears to apply not to the definitive larva, but to its first stage, is to be taken as "demonstrative" of the affinity of the Strepsiptera to the Neuroptera. No stress can be laid upon the free elongated anterior and middle coxæ in a case in which, as here, we have to deal with the orders of insects. Thus the only remaining arguments for the affinity of the Strepsiptera to the Phryganidæ, and their consequent position among the Neuroptera, are that the buccal organs are rudimentary, and the prothorax is formed as in the Phryganidæ. A rudimentary condition of the buccal organs, with which an amalgamation of the different parts is always associated, does not of itself form any relationship. The buccal organs are aborted in certain genera of all orders of insects, and indeed in such as take no nourishment in the imago state, as in *Ephemera* among the Orthoptera, in the *Henopii* among the Diptera, and in many Bombycidæ among the Lepidoptera. The rudimentary state of the buccal organs is therefore no argument against the position of the Strepsiptera among the Coleoptera; they are Beetles with rudimentary buccal organs, just as the Phryganidæ are Neuroptera with rudimentary buccal organs, if, indeed, from the nature of the anterior wings the Strepsiptera are Beetles, and the Phryganidæ Neuroptera.

"The Strepsiptera agree with the Phryganidæ in the structure of the prothorax, which never occurs in the Coleoptera." According to the diagnoses of the Phryganidæ (p. 75) and the Strepsiptera (p. 78), this structure consists in the prothorax being short and annular. A prothorax is annular when it consists of a single ring, and is not divided into a notum and a sternum. But a prothorax of this kind, forming only a simple ring, occurs among Beetles throughout the division Rhyncho-phora. On the other hand, it is by no means settled, and indeed cannot be settled from dried specimens, that the very slightly developed prothorax of the Strepsiptera does not consist of a notum and a sternum. The only thing that remains, therefore, is that the prothorax is short in the Phryganidæ and

Strepsiptera, and free and strongly developed in the Coleoptera. If, then, the Phryganidæ and Strepsiptera, although they possess a short prothorax, are referred to the Neuroptera, among the ordinal characters of which a free prothorax is one (p. 68), this proves, on the one hand, that the above-cited diagnosis does not apply to the numerically larger part of the Neuroptera (the Phryganidæ), and, on the other, that the development of the prothorax does not furnish a character for the order Neuroptera.

Even in the order Hymenoptera the development of the prothorax has not the decided signification which is ordinarily ascribed to it: in most cases indeed it, or at least its notum, is much reduced; but in the family Pompilidæ (for example, in *Salix*) it is well developed. That in the orders of Hemimetabolous Insects (Orthoptera, Hemiptera) the prothorax is sometimes free, sometimes more or less reduced *in correspondence with the structure of the anterior wings*, has already been fully elucidated by Erichson (Germar's 'Zeitschrift,' i. p. 156). The shortness of the prothorax, therefore, proves nothing in favour of the position of the Strepsiptera among the Neuroptera (which, for the most part, possess a free prothorax), and can only be used as an argument against their being placed with the Coleoptera if we refuse to admit that the prothorax may be reduced in this order exceptionally, and indeed in the strictest connexion with the reduction of the anterior wings, just as among the Hymenoptera it is exceptionally strongly developed in *Salix*. In this case we have to regard the Strepsiptera as forming a small independent order, agreeing with the Coleoptera in the perfect metamorphosis, in the possession of (rudimentary) biting oral organs, and in the structure of the wings; and with certain Coleoptera in a very peculiar process of development, but differing in the rudimentary condition of the prothorax*. But in other cases we arrange certain forms in an order, although one or other of the characters of this order do not attain full development in them; for example, we unite the genus *Braula* with the Diptera with reference to certain conditions of organization, and to its development, which takes place as in the section Pupipara of the order Diptera, although it does not possess the essential characters of that order, namely the halteres and the typical structure of the mouth; and if we do so, we may also with perfect justice refer the Strepsiptera to the Coleoptera.

That the mode of life of the Strepsiptera agrees with that of the Meloidæ, so far as the nourishment of the larva is concerned, has never been asserted. It has, however, been affirmed, and correctly, that in this and other respects it agrees with that of

* With regard to the asserted distinction in that the anterior wings are moved when the animals fly, see Lacordaire's 'Gen. Col.' v. 11. p. 693.

the Coeopterous genus *Rhipidius* (= *Symbius*), which is parasitic in Cockroaches, as the Strepsiptera in Bees and Wasps, and the vermiform female of which does not quit the body of the animal in which it has been developed, any more than the worm-like female of the Strepsiptera. But the Strepsiptera agree with the Meloidæ (*Meloë* and *Sitaris*, and probably also with *Rhipidius*, the metamorphosis of which is not completely known) in the very remarkable process of development named *hypermetamorphosis* by Fabre, which has hitherto been observed in this form only in the Meloidæ and Strepsiptera—a process which consists in the production from the egg of a provisory larva, destined to transfer the animal into those conditions under which it is further developed, and in the production from this provisory larva, at the first moult, of a second definitive larva of totally different form.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

April 12, 1864.—E. W. H. Holdsworth, Esq., in the Chair.

NOTES ON THE UROTRICHUS. BY J. K. LORD, F.Z.S.

UROTRICHUS GIBBSII, Baird.

Hab. Western side of Cascade Mountains, Sumass Prairie, near Fraser River.

This singular little animal, which appears to be an intermediate link between the Shrew and the Mole, is at present only known as an inhabitant of two parts of the world, widely removed from each other—the one spot being the western slope of the Cascade Mountains in North-west America, the other Japan. There are, as far as I know, but two specimens extant from the Cascade Mountains,—one in the Smithsonian Museum at Washington; the other, a very fine specimen, that I have recently brought home, and which is now in the British Museum. I have carefully compared the Japanese *Urotrichus* with his brother from the western wilds, and can find no difference whatever, either generically or specifically; in shape, size, and colour they are exactly alike.

The *Urotrichus* is of a bluish black when *fresh*, but in the dried specimens sooty brown. The hair is lustrous and where it reflects the light has a hoary appearance, and, like that of the Mole, can be smoothed in either direction. This is a wise and admirable arrangement, as it enables him to back through his underground roads, as well as to go through them head first. His nose or snout is very curious, and much like that of a pig, only that it is lengthened out into a cylindrical tube covered with short thick hairs, and terminating in a naked fleshy kind of bulb or gland; this gland is pierced by two minute holes, which are the nostrils. Each nostril has a little fold

of membrane hanging down over it like a shutter, effectually preventing sand and small particles of dust from getting into his nose whilst digging. This curious nasal appendage is to him not only an organ of smell, but also serves the purpose of hands and eyes. His fore feet, as I shall by-and-by show you, are wholly digging-implements, and, from their peculiar horny character, not in any way adapted to convey the sense of touch. Eyes he has none, and but a very rudimentary form of ear; so that his highly sensitive, moveable nose serves him admirably in the dark tunnels in which his time is passed to feel his way and scent out the lower forms of insect-life on which he principally feeds. Had he eyes, he could not see, for the sunlight never peeps in to cheer his subterranean home; and sound reaches not down to him; but his nose in every way compensates for all apparent deficiencies. His fore feet are, like the Mole's, converted into diggers; the strong scoop-shaped nail, like a small garden-trowel, at the end of each toe enables him to dig with wonderful ease and celerity. The hind feet are shaped into a kind of scraper, by the toe being curiously bent. The length of the hind foot is about two-thirds more than that of the fore or digging hand.

When I come to speak of his habits as differing from the Mole, I shall be able to demonstrate the use of this strange scraper-like form of hind foot. So far, I have endeavoured to give an outline of his general personal appearance, differing from the Shrew in the peculiar arrangement of his feet, and from the Mole in having a long hairy tail. His nearest relative is the *Condylura* (Star-nosed Mole), whose nose has a fringe of star-shaped processes round its outer edge, about twenty-two in number.

The first and only place I ever met with this strange little fellow was on the Chilukweyuk Prairies. These large grassy openings or prairies are situated near the Fraser River, on the western side of the Cascade Mountains. In the sandy banks on the edge of the Chilukweyuk River and the various little streams winding through the prairie-grass, lives the *Urotrichus*; his subterranean home is a large space or hole excavated like a small cave, and lined with bits of dry grass and leaves. From the central residence roads are tunnelled away, radiating from it like the spokes of a wheel. His tunnels are not like those of the Mole; he never throws up heaps or mounds of earth in order to get rid of the surplus material; he digs as the Mole, but makes open cuttings at short intervals, about four or five inches long.

And now we shall see the use of those curiously formed scraper-like hind feet. As he digs out the tunnel with his trowel hands, he throws back the earth towards his hind feet. These, from their peculiar shape, enable him to back the dirt out of the hole, using them like two scrapers, only that he *pushes* the dirt instead of pulling it towards him. Having backed the dirt clear of the mouth of the hole, he throws it over the edge of the open cutting. After having dug-in some distance, and finding, I dare say, the labour of backing out rather irksome, he digs up through the ground to the surface, makes another open cutting, and then begins a new hole

or tunnel, and disappears into the earth again. When he has gone as far from his dormitory as he deems wise, he again digs up through and clears away the rubbish. This road is now complete; so he goes back again to his central mansion, to begin others at his leisure. It is very difficult to watch the movements and discover the feeding-time and food of an animal that lives almost wholly underground in the daytime; but I am pretty sure these tunnels are made for and used as roadways, or underground trails, for the purpose of hunting. He is a night feeder, and exposed to terrible perils from the various small Carnivora that prowl about like bandits in the dark—Stoats, Weasels, Martins, and Skunks. So, to avoid and escape these enemies, he comes quietly along the subterranean roadways, and cautiously emerging at the open cutting, feels about with his wonderful nose, and, I doubt not, guided by an acute sense of smell, pounces upon larvæ, slugs, beetles, or any nocturnal creeping things he can catch, and so, traversing his different hunting-trails during the night, manages in this way to fare sumptuously, safe from danger.

It is scarcely possible to imagine a more skilfully contrived hunting-system, to avoid danger and to facilitate escape, than are these tunnel trails with open cuttings; for the sly little hunter has, on the slightest alarm, two modes of flight at his disposal, one before and the other behind; and the fur, as I have already mentioned, lying as smoothly when stroked from tail to head as it does when turned in the natural direction, enables him to retreat tail first into his hole as easily as he could go adopting his usual mode of progression.

NOTICE OF A PORTION OF A NEW FORM OF ANIMAL (MYRIO-
OSTEON HIGGINSII), PROBABLY INDICATING A NEW GROUP
OF ECHINODERMATA. BY DR. JOHN EDWARD GRAY, F.R.S.,
F.L.S., ETC.

Four or five years ago the Rev. H. H. Higgins, of Liverpool, purchased in London a specimen which was shown at the time to several naturalists, and was pronounced by some to be the tail of a Ray (perhaps of *Urogymnus africanus*); and this determination seems to have been so far satisfactory that up to this period it has not been further described.

During a recent visit to the Free Museum at Liverpool the specimen attracted my attention, and Mr. Moore, the intelligent Curator of that institution, placed it in my hands for examination and determination; and the trustees of that institution have most kindly presented it to the British Museum. I was soon satisfied that it could not be the tail of a Ray, nor, indeed, a part of any vertebrated animal. The outer surface (and, indeed, the whole substance) is made up of a number of calcareous concretions, united together by anastomosing processes placed on the outside of an internal rather thick coat formed of longitudinal fibres, which is rather hard and firm when dry. The interior of the tapering tube is quite empty, without any septa or other divisions.

It is very unlike the skin of a cartilaginous fish, which is always a good firm skin, more or less studded with hard, imbedded, bony scales or processes, or the case of an *Ostracion*, which is formed of cartilaginous or horny tesserae. The rounded surface, which has been regarded as the upper surface of the tail, is pierced with two series of small, rather unequal-sized, oblong holes, which look very like irregular ambulacra for the passage of the feet or tentacles of the animal which formed the body, as in the case of the Star-fishes; and yet, at the same time, these holes are very different from the ambulacral pores of those animals, which are always in pairs and surrounded by some special ossicles. Besides the holes on the rounded or upper edge, there are a few similar perforations, but smaller in size, on the sides of the thicker part of the tube.

The entire surface of the external skeleton is cribellated with small pores between the ossicles, as is the case with many *Asteriadae* and *Echinidae*. This porousness of the surface induced one of the naturalists to whom it was shown to suggest that it might be the shell of a gigantic Foraminifer, or the coral of one of the Polyzoa; but this opinion cannot be entertained, as the pores are very unlike the pores of those animals, and the large continuous internal cavity, which has been evidently occupied by some part of a larger animal, is totally opposed to such a theory.

I therefore propose to give it a name, in hopes that it may lead to a more perfect knowledge of the animal, and to characterize it thus:—

MYRIOSTEON, gen. nov.

Body, entire form unknown. The part alone known (fig. 1) is elongate, tapering, straight, rather compressed, rounded above, and flattened beneath; the sides and upper surface formed of convex tetragonal ossicles, united by short radiating branches; with four or five round pores round each ossicle; ossicles of nearly equal size in all parts of the surface.

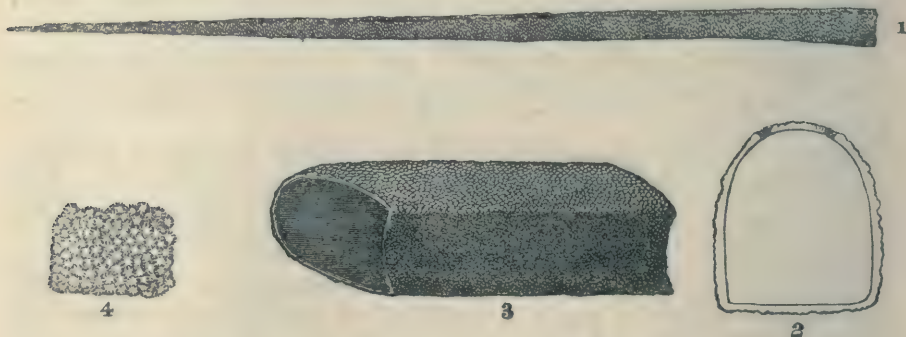


Fig. 1. The entire specimen, greatly reduced.
 2. Cross section of the specimen, natural size.
 3. Side view, showing the flat under surface.
 4. Figure of the surface, natural size.

The lower surface flat (figs. 2, 3, & 5), formed of smooth flat-topped tesserae, which are very close together, forming a nearly continuous

surface, with circles of six triangular radiating pores near the margin of each ossicle—the ossicles near the thickest part of the body being the largest, and very gradually diminishing in size towards the top.

The ossicles are all placed on a rather solid, thick, hard internal layer, which is formed of closely intertwined short longitudinal fibres, or opaque bone-like spicula, which seem to give considerable rigidity to the body.

The convex upper edge has two longitudinal series of oblong pores, rather unequal in size, and sometimes placed so close together as to run nearly into one another, and at others separated from each other by a considerable interval. The larger pores are surrounded by a slightly raised edge, showing that some tentacle or other body is emitted through them. There are also a few smaller circular pores scattered on the sides of the tube.

MYRIOSTEON HIGGINSII, sp. nov. (Figs. 1–5.)

Hab. — ?

The fragment of this animal, which alone is known, is $26\frac{1}{2}$ inches long and 3 inches in circumference at the base, tapering to a rather blunt end, which is pervious; but it is evidently imperfect, and may be closed in the perfect state. The flattened part of the base is rather more than half an inch wide at its widest part.

I have named the specimen after the Rev. H. H. Higgins, one of the trustees of the Derby Museum at Liverpool, well known for his attachment to science.

I was soon convinced that the specimen was not the tail of a Ray, nor indeed any part of a vertebrated, annulose, or molluscos animal; so that it must belong to the radiated group; and the question is to which part of the group it is most nearly allied.

The formation of the external skeleton and the general form of the parts which alone have as yet been examined lead me to believe that it is part of an Echinoderm, being probably the single ray of a radiated body. The structure of the external skeleton resembles more closely that of one of the more tessellated forms of the cylindrical-rayed Starfish than that of any other animal that has occurred to me; but it differs from the arms of these animals in not being provided with regular ambulacra, which is the essential character of the Starfish.

I am therefore induced to believe that the specimen may indicate a new group of radiated animals, nearly allied to *Asterias*. It appears to be much more rigid than the Starfish are in general; and it will at any rate form a new family, for which the name of *Myriosteidae* may be given.

I do not recollect to have seen any fossil that has any resemblance to the specimen, or to the separate parts of it.

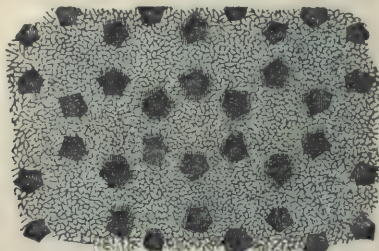
The ossicles differ also from those of *Asterias* in not being covered with granules, and from the *Asteriadae* and *Echinidae* in not being provided with spines on moveable joints.

The lateral edges of the flat portion of the specimen are more or less distinctly marked, and in some places, especially near the small end, are raised up into an irregular margin, formed by irregularities

on the surface of the ossicles, which at these places are more or less confused together.

The centre of the upper part of the smaller end of the specimen is marked with scattered concavities, which appear as if formed by its having been attached to some shell or other more or less convex surface. These concavities are produced by the flattening of the surface of the ossicles of the part. They may have been produced by parasites which have affixed themselves to the surface of the specimen, or by the specimen itself having been attached by the end of this part of the body to some fixed body. The pores on the back are more symmetrical and equal near the end of the arm, and those

Fig. 5.



Magnified figure of the under surface, showing the large pores placed in hexagons.

in each series are generally opposite to each other; but there are many exceptions to this arrangement and symmetry.

The *Myriosteon* can have no affinity to the Polyzoa, for there are no cells for the reception of the animal. The celebrated French zoologist who suggested that it might possibly belong to that order compared it with *Eschara*, the cells of which are obliterated by age; but then the cells are always well developed in the younger part of the coral.

The specimen under examination is clearly not a coral gradually increasing in size by the development of new cells, but a definitely-shaped part of some regularly formed body; so that the idea of its being a Polyzoon is scarcely worthy of as much consideration as I have given to it.

April 26, 1864.—John Gould, Esq., F.R.S., in the Chair.

NOTE ON THE BONNET OF THE RIGHT WHALE.

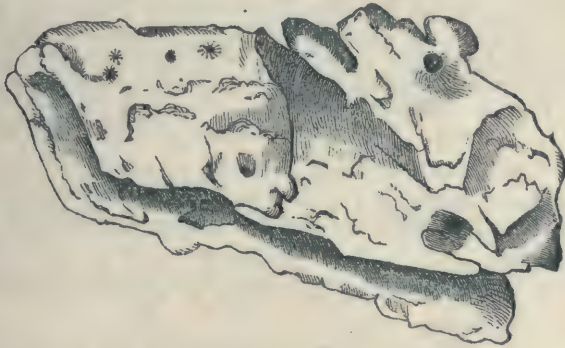
BY DR. J. E. GRAY, F.R.S., F.L.S.

Mr. Holdsworth has presented to the British Museum a specimen which had been received from an American whaler, as “the Bonnet of *Balæna mysticetus*, obtained at the Sandwich Islands.”

I have shown the specimen to Professor Owen. He states that a similar specimen is in the Museum of the College of Surgeons, and that he considers it as “a diseased action or tumour of the outer layers of integument.”

The specimen is oblong, 11 inches long, and 8 inches wide, very irregular in the outline, with a very rough pitted surface, four of the

pits being much larger than the rest, and dividing the surface into six prominences. The whole substance seems to be formed of irregular horny layers placed one under the other, the lowest layer being the



one last formed ; and each of these layers is more or less crumpled and plicated on the surface, giving the irregular appearance to the mass.

The lower layer is attached to the skin of the whale, a part of the skin being attached to the inner surface of the mass, or bonnet, as it is called.

On showing the specimen to a foreign zoologist, he stated that it was an excrescence on the skin of a whale, formed by the adhesion of the barnacles called *Coronula*, and that the irregularities on the surface of the bonnet were caused by the attachment and wearing-action of these animals.

This is quite a mistake, the *Coronulæ* sink themselves into the epidermis of the whale, as is also the case with the genus *Tubicinella*. I have seen numerous specimens of both these animals *in situ*, and the skin round the cirripedes is scarcely altered in structure, and offers no resemblance to the horny excrescence called the bonnet. Any one who examines the bonnet will find that the plate of horn of which it is formed is plicated and folded when deposited ; and this explains the irregularity of the general form of the body.

The zoologist referred to has since said that he believes it is caused by the irritation of the whale-louse, and that the irregularities on the surface are caused by them. This may perhaps have arisen from the surface of the specimen being covered with whale-lice when it was first procured from the whaler ; but this may be only because the hollow on the surface forms a good hiding-place for them ; and I think the supposition that they are the origin of the wart or horn requires further observation.

Mr. Holdsworth has since sent to the Museum a much smaller specimen, also obtained at the Sandwich Islands, which is oblong, elongate, and more symmetrical ; but the upper surface is not so evenly channelled. It is 6 inches long and $2\frac{1}{2}$ wide. It is spoken of by the whalers as a wart on the tip of the nose, and is commonly called the "Whale's bonnet."

I do not recollect observing any notice of this "*bonnet*," or giant corn, or rudimentary frontal horn, as it may be regarded, in any ac-

count of the "Right Whale," nor in that of the "Spermaceti Whale." I have specially searched for it again in the works by persons who have seen these Whales alive, but without success.

It has been suggested by Mr. Holdsworth that the bonnet may be a natural development, and possibly characteristic of the species; he thinks that the "pale prominence" on the nose of *Balæna antarctica*, as figured in 'Fauna Japonica,' pls. 28 & 29, may be intended to represent it. In the description this part is only described as "une forte proéminence teinte de blanc."

In the excellent drawing of the male Whale from the coast of New Zealand, which I figured under the name of *Balæna antipodarum*, in Dieffenbach's 'New Zealand,' vol. ii. t. 1, there is a rough roundish prominence on the front of the lower jaw, as well as on the front of the upper one.

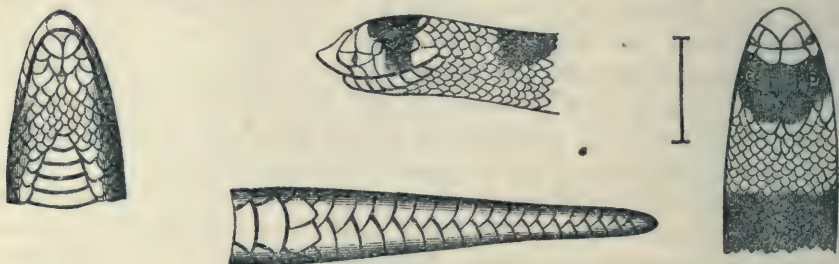
I believe that a prominence of the kind is to be observed in all the species of the genus *Balæna*, although I have never seen them described as hard and horny; but that is no reason why this may not be the case.

DESCRIPTION OF THREE NEW SPECIES OF AUSTRALIAN SNAKES. By GERARD KREFFT.

SIMOTES AUSTRALIS, sp. nov.

Scales in 17 rows. Ventrals 160 to 163. Anal bifid. Subcaudals 18/18. Total length $11\frac{1}{2}$ "; tail $1\frac{1}{8}$ ".

Body cylindrical, rounded; head short, conical, not distinct from neck; tail short, ending in a blunt point. Rostral shield much pro-



duced, flat in front, pointed behind, reaching backwards to between the anterior frontals, slightly grooved at its base. Two nasals, nostrils between, one anterior, two posterior oculars; two temporals (in one specimen a third smaller one behind). Eye small; pupil subelliptical, erect; no loreal, replaced by the posterior nasal and anterior ocular; six upper labials, the third and fourth coming into the orbit; occipitals short, not much rounded behind, and but slightly forked. The general colour is red, very bright on the posterior part of the body and tail; all the scales are slightly margined, some, much darker than others, have a whitish (in spirits) spot in the middle, and form into a series of half rings, of which there are about fifty-six upon the body and tail. The head is covered by a black band across the occiput, leaving the snout free, commencing from below

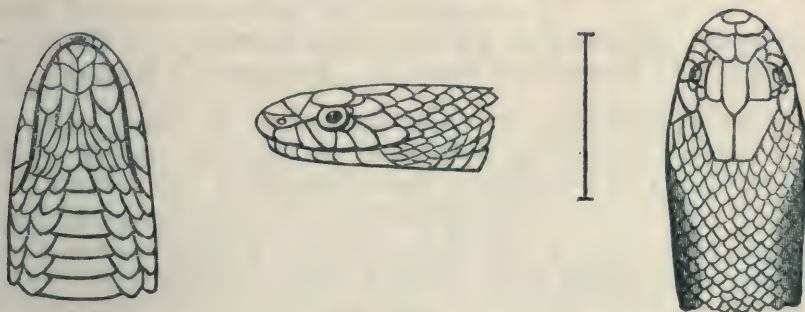
the eye, and marking the fourth and fifth upper labials, the vertical, and nearly the whole of the occipitals; this black band is divided from a second band covering the neck by a whitish space.

I believe the present species is the first *Simotes* discovered in Australia; and I am much indebted to Dr. James C. Cox, who found it in the neighbourhood of Port Curtis. A second specimen, taken on the banks of the Clarence River, was given to me a few days ago by Judge Francis.

HOPLOCEPHALUS RAMSAYI, sp. nov.

Scales in 15 rows. Anal bifid. Ventrals 164. Subcaudals 51. Total length $10\frac{1}{2}$ "; tail 2".

Body rather elongate and rounded; head scarcely distinct from



neck, rather high and elongate, with obtuse muzzle; rostral just reaching to the surface of crown; anterior frontals moderate, rounded in front; posterior ones larger, bent down on the sides; one anterior, two posterior oculars, the lower forming about one-fourth of the orbit; vertical narrow, six-sided, much longer than broad; superciliaries nearly the same size as the vertical; occipitals moderate, not forked behind; six upper labials, the third and fourth forming the lower part of the orbit; no loreal, replaced by the elongate nasal, second and third upper labial, anterior ocular, and bent down anterior frontal. One nasal, pierced by the nostril; scales moderate, rhomboid, in fifteen rows; tail rather short, scarcely distinct from trunk, tapering; eye moderate, pupil rounded; grooved fang in front, some smaller smooth teeth behind.

Dark olive-green above, each scale tipped with reddish, in particular those on the sides; crown and a narrow vertebral line, one scale wide, somewhat darker than the other parts; this line extends to the root of the tail; upper labials and chin-shields whitish, marked with olive-brown in the upper corners. Beneath yellow, each ventral scale with a blackish margin; subcaudals nearly black.

Mr. E. P. Ramsay discovered this new Snake in the neighbourhood of Braidwood, N. S. Wales; it is apparently a young specimen, its total length not exceeding $10\frac{1}{2}$ inches.

HOPLOCEPHALUS NIGRO-STRATUS, sp. nov.

Scales in 15 rows. Anal entire. Ventrals 180. Subcaudals 62. Total length 11"; tail $2\frac{1}{2}$ ".

Body and tail as in *H. nigrescens*; belly flat; tail moderate, not distinct from trunk; head not distinct from neck, depressed, rounded; rostral moderate; anterior frontals broad, hinder edges just touching the nostril; posterior frontals much larger, rounded behind; vertical moderate, six-sided, very broad; occipitals rather narrow, elongate, much forked and pointed behind; one anterior, two posterior oculars; superciliaries and eyes small; pupil elliptical, erect; six upper labials, third and fourth touching the eye. Upper part of posterior half of tail covered with large hexagonal scales; sides and beneath yellowish white; crown and a vertebral line running from the neck to the tip of the tail black.

Hab. North-east Australia, neighbourhood of Rockhampton.

NOTES ON AUSTRALIAN FRESHWATER FISHES, AND DESCRIPTIONS OF FOUR NEW SPECIES. BY GERARD KREFFT.

The scanty knowledge which we possess of the fishes inhabiting our freshwater streams has induced me to pay some attention to this subject; and I now furnish a list of species of the several rivers from which I have received specimens. To begin with our immediate neighbourhood, I find that up to the present time not more than four species have been captured in the streams emptying into Port Jackson and Botany Bay:—namely, *Eleotris australis*, sp. nov.; *Mugil dobula*, Gthr.; *Anguilla australis*, Rich.; and *Galaxias scribea*. These four species we find in almost every stream, swamp, and lagoon, *Galaxias scribea* even in old wells or other water-holes on the top of hills, which have no connexion with any of the running streams. *Anguilla australis* is also frequently found in detached pools of water; whilst *Eleotris australis* frequents the clearer streamlets. I have never had an opportunity of examining the creeks which are situated upon the north shore of Port Jackson, nor have I ever received specimens captured there; but I have reason to believe that, besides the four kinds of fish mentioned, there exists a larger freshwater species, commonly called “Perch,” probably a *Therapon*, which is not found in the salt water of the harbour.

With regard to the fishes of the Nepean or Hawkesbury, its tributaries, and the swamps and lagoons with which this river is occasionally connected during high floods, I am enabled to give a better account. I have drawn the seine in the Hawkesbury between Windsor and Richmond, about fifty miles from its mouth, where the water is as fresh as that of any mountain-stream; and the result was, at a haul, about 200 so-called “Mulletts” (two species, *Mugil dobula*, Gthr., and *Mugil compressus*, Gthr.), two “Eels” (*Anguilla australis*, Rich.), a “Perch” (*Lates colonorum*, Gthr., Ann. N. H. 1863, xi. p. 114), and a “Rock Cod” (*Dertropogon robustus*, Gthr.). How this last fish managed to go so far up a freshwater river I could not understand. It has all the appearance of a true sea-fish; and yet I took it subsequently much further up the river, between the mountains, whilst I have also received two specimens captured with

hook and line in Mr. Pitt's lagoon near Bronte—a lagoon which, Mr. Pitt informs me, has not been flooded during the last four years. There is another fish, called a "Bream" by the settlers, which we did not succeed in capturing (this is probably *Beryx affinis*), and a second species of Perch, which may prove to be new. At a second haul a true Flat-head (*Platycephalus tasmanius*, Rich.) was secured, besides the usual amount of "Mullet" and "Perch." The smaller fry, as *Galaxias scriba*, Rich., and the so-called Sprat (*Megalops setipinnis*, Rich.), were taken with hook and line. The last-mentioned species affords a good deal of sport, as it will rise to a fly. I mention this fact, as some authors have denied that fly-fishing existed in Australia.

The genus *Eleotris* I found well represented in this river; and I give a short description of four new species.

ELEOTRIS COXII, sp. nov.

D. C. $\frac{1}{9}$. A. $1/9$. L. lat. 36 to 38.

Twelve series of scales between the origin of the posterior dorsal and the anal. Head scaly; snout obtuse, with the lower jaw prominent. The height of the body is contained five times and a quarter in the total length; the length of the head more than four times; the horizontal diameter of the eye is one-fourth of the length of the head, and equal to the width of the interorbital space.

Coloration bright yellow; upper part and sides finely punctured with black, forming a broad, sometimes indistinct streak upon the sides. Dorsals and pectorals bright yellow at the base, the first punctured with black; belly whitish. Teeth villiform, in broad bands. Anal papilla large, somewhat longer than broad.

Total length $5\frac{1}{4}$ inches.

Hab. Lagoon near Bronte, Upper Hawkesbury River.

ELEOTRIS AUSTRALIS, sp. nov.

D. $7\frac{1}{8}$. A. $\frac{1}{8}$. L. lat. 32.

Eight series of scales between the origin of the posterior dorsal fin and the anal. Head scaly, as far as the snout, obtuse; lower jaw prominent; teeth in villiform bands. The height of the body is contained four times and a half in the total length, and the head four times and a quarter; the horizontal diameter of the eye is one-half the width of the interorbital space. General coloration yellowish brown, covered with minute black spots, which form five or six longitudinal lines upon the sides; base of pectorals with a narrow bright yellow band; all the rays of the caudal spotted with black; second dorsal with three or four narrow, sometimes indistinct bands. Anal papilla as long as the horizontal diameter of the eye, and nearly as broad. Total length 5 inches.

Hab. Creeks near Sydney, Hawkesbury River and its tributaries, Hunter River, and Clarence River.

ELEOTRIS GRANDICEPS, sp. nov.

D. 7 $\frac{1}{9}$. A. $\frac{1}{9}$. L. lat. 38 to 40.

Twelve series of scales between the origin of the posterior dorsal fin and the anal. Head very large, broad, depressed, without any apparent scales; lower jaw prominent; teeth villiform. The height of the body is contained five times in the total length, and that of the head three times and a half. The diameter of the eye is one-fifth of the length of the head, and nearly one-half of the interorbital space; the pectorals reach to the origin of the anal fin. General coloration yellowish, punctured with black in particular on the upper part and sides; snout blackish; lower jaw sometimes punctured with black also; beneath whitish. Anal papilla very small. Total length $3\frac{1}{2}$ inches.

Hab. Upper Hawkesbury River; freshwater lagoons near Bronte and Richmond, Eastern Creek, and other tributaries of the Hawkesbury.

There are just twelve species of fishes from the Nepean and Hawkesbury; but I am assured by Mr. George M. Pitt, jun., to whom I am chiefly indebted for my specimens, that the river contains more than twenty different kinds of fish: the remaining species I hope to capture during the course of this summer, and I shall furnish an account of them in due time. Of our northern rivers the Hastings, the Richmond, and the Clarence I know but little; that they teem with fish there is no doubt, and that many new genera and species will be found amongst them is certain. Many of the settlers upon the banks of these streams have promised their cooperation; and Mr. James F. Wilcox, who resides on the Clarence River, has supplied me already with many interesting specimens. I received from him *Oligorus macquariensis*, Cuv. & Val., *Therapon unicolor* (?), *Galaxias scriba*, Rich., *Eleotris mogunda*, Rich., and *E. compressus*, sp. nov., which may be described as follows :—

ELEOTRIS COMPRESSUS, sp. nov.

D. C. $\frac{1}{9}$ to 10. A. $\frac{1}{10}$. L. lat. 28/30.

Eight series of scales between the origin of the posterior dorsal fin and the anal. Body cyprinoid, compressed; the height of the body is contained three times and three-quarters in the total length, and the head four times; the horizontal diameter of the eye is one-fourth of the length of the head, and is contained once and a half in the interorbital space; the snout is short, lower jaw longest; mouth rather small; head scaly.

Coloration reddish brown, with five or six indistinct cross bands, formed of the close-dotted black spots with which the scales are covered. The second dorsal and the anal are rather long, and more or less marked with black at the base and top; besides this, the hinder

part of the second dorsal is speckled with white. Anal papilla of moderate size and forked. Total length $3\frac{1}{2}$ inches.

Hab. Clarence River, and creeks near Port Denison. Discovered by Mr. James F. Wilcox.

DESCRIPTION OF A NEW SPECIES OF THE GENUS *MERGUS*.

BY JOHN GOULD, F.R.S., ETC.

MERGUS SQUAMATUS, Gould.

Crown of the head, lengthened crest, and neck rusty brown; upper surface brownish grey; tuft of feathers at the insertion of the wing grey, passing into white near the tip, and broadly margined with black; lesser wing-coverts grey; greater coverts grey at the base, passing into black about the middle of the feathers, beyond which they are creamy white; primaries very dark or blackish brown; lower part of the throat and all the under surface pale buff; sides of the breast and the whole of the flanks down to the tail deep rich buff, with two narrow irregular crescentic bands of blackish brown on each feather, one within the other, the outer one near the edge, the inner one near the middle; a similar style of marking pervades the space behind the legs, the lower part of the back, and the upper tail-coverts, but the markings in those parts are wider, of a greyer tint, and intermingled with each other; tail greyish brown, the central feathers freckled on their margins with greyish white.

Total length 23 inches; bill $2\frac{3}{4}$; wing 10; tail $4\frac{1}{2}$; tarsi 2.

Hab. China.

Remark.—The above description was taken from an example which I consider to be either immature or in its winter livery. In size it is intermediate between *Mergus castor* and *M. merganser*. Whenever a specimen is procured in its nuptial dress, it will doubtless prove to be a bird of great beauty. This new species is at once distinguished from the other members of its genus by the squamate form of the markings on the flanks, which has suggested the specific name assigned to it.

May 10, 1864.—Dr. E. Hamilton in the Chair.

ON A NEW RAT FROM FORMOSA. BY ROBERT SWINHOE, F.Z.S.

MUS CONINGA, n. sp.

M. corpore supra rufo, setis nigris spinosis sparso, subtus abrupte albo: auribus rotundis, fuscis: cauda longa, squamosa, setosa: pedibus albis.

Corp. long. 8 poll., caud. 9 poll.

Upper parts reddish brown, sprinkled with stiff black bristles, more especially on the back, where the fur is also often a little dark; ears and fore part of legs deep brown; tail composed of short rings of scales set with short stiff bristles, deep brown on its upper parts, whitish on the lower and for about $1\frac{3}{4}$ inch of tip; a ring of black runs round the lids of the eye; whiskers on sides of muzzle and a

few hairs on sides of the forehead very long and glossy black; fore teeth rufous sienna, those on lower jaw long; chin, breast, under fore paws, belly, and under thighs pure white; paws white, the hinder ones large.

In a young animal, measuring $6\frac{1}{2}$ inches in trunk, the tail measured 6 inches; head to fore root of ear $1\frac{1}{2}$ inch; between ears $\cdot 7$ inch; length of ear $\cdot 8$ inch; greatest breadth of ear $\frac{1}{2}$ inch; hind foot, from tibial joint to end of nails, $1\cdot 4$ inch. As the animal attains its full size, the tail exceeds the trunk in length. I have examined about thirty-five specimens of different ages; the younger the animal, the fewer spinous bristles: of these the males carry most; they are sharp and very stiff. Amongst these specimens there is, as usual, an amount of variation; but in proportions it is not very appreciable, except in so far as to be accounted for by age. In colour, on the contrary, varieties abound: the most strongly marked are the following:—

1. Sides strongly freckled with olive-yellow.
2. Brown, with more or less reddish; fur softer, with few bristles.
3. Similar to 1, but with brown instead of white fur.
4. Similar to 1, with white-and-brown feet and white-patched tail.
5. Characters of nos. 2 and 1 united.

These five varieties are so linked together by intermediate forms that there is no drawing a line between them. When I received the first soft-furred brown Rat, I thought I had got a distinct creature; but I soon procured others combining the characters of both. The colour and softness of its fur led me to conjecture that it might be a race of which the ancestors had hybridized with *Mus decumanus*, because I received a specimen of this last animal from the same locality. But the acquisition of further specimens showed me that, from the unsullied whiteness of its belly and the intermediate tinges of the upper parts of many others, the difference only consisted in a slight variation in the colour and appearance of the fur, the other characteristics of the species remaining unaltered. This Rat is not now found in the vicinity of towns, whence, like the indigenous Rats of most countries, it has fallen back before the usurpation of the stronger hordes of the commercial Rat (*Mus decumanus*); and it is now only found in the isolated hamlets of the interior, whither its enemy appears gradually to be extending its sway. It is difficult to understand how so large and strong a Rat has been ousted out of its rights by a not much stronger usurper. This species must have occurred formerly in towns in pretty considerable numbers, as it still does in country places. The imported hordes of *Mus decumanus* could not have been in larger numbers, but I should fancy must have employed a superior cunning to deprive these of their territory—much the same sort of advantage, probably, that civilization gives the Chinaman in this country, and the whites in Australia, which enables them to drive into the mountains and bush the rightful but less expert possessors of the land of their fathers. This Rat is allied to the aboriginal Rat of Southern China (*Mus flavescens*, Gray), and doubt-

less of the same stock ; but it attains a larger size, is robuster, has larger hind feet, larger ears, and is otherwise distinguished by its feet being white, and by the pure abrupt white of its under parts. The bristles of its upper parts are also more numerous and more spinous. It was, perhaps, originally brought over by Chinese junks, and drove before it some other species, of which some few may yet be found lingering about the huts of the savages of the interior. For, in former days, before the accession of western commerce, *M. flavescens* was doubtless the chief Rat of the towns of Southern China ; and special circumstances may have caused it to vary ; or its pedigree may perhaps be carried further back to the time when there must have been more territorial connexion between this island and the main, when *Lepus sinensis*, *Cervulus Reevesii*, and others managed to get across and remain to this day in either country identical and unchanged in form. These, however, are merely conjectures ; but the facts remain that *Mus Coninga* is allied to *M. flavescens*, and that both have been banished from their accustomed haunts by the cosmopolite usurper, *M. decumanus*.

The Formosan Rat is distinguished by the Chinese colonists from *M. decumanus*, which they call *Laou chee*, by the name *Pay-ba*, or white belly. The country-people attribute medicinal properties to its flesh, and value its carcase at fourpence a piece. I propose to name the animal after the powerful pirate chief who seized the island from the Dutch, and whose nightly rest this indigenous species must have as greatly disturbed as do its commercial successors those of the present trading community.

ON A NEW SPECIES OF WHITE COCKATOO LIVING IN THE
SOCIETY'S GARDENS. BY P. L. SCLATER, M.A., PH.D.,
F.R.S., SECRETARY TO THE SOCIETY.

In April of the year before last the Society obtained from the ship 'La Hogue' (as recorded in the 'Proceedings' for May 13, 1862)* a pair of a fine large species of White Cockatoo, new to the collection. Somewhat influenced, I must confess, by the information that they had been brought to Sydney from the Salomon Islands, I was induced to refer these birds to the *Cacatua Ducorpsii*, obtained by MM. Hombron and Jacquinot in that group of islands, and described by those naturalists in the Zoology of the 'Voyage au Pôle Sud,' although they did not quite agree with the characters and figure there given of that species.

On its return voyage this year the same ship has brought over a pair of smaller White Cockatoos, received at Sydney from the island of Guadalcanar, of the Salomon group. As soon as I saw them, I was at once convinced that I had made a mistake in referring the former pair of birds to *Cacatua Ducorpsii*, and that the latter pair were rightfully entitled to that designation. It thus becomes neces-

* See P. Z. S. 1862, p. 141.

sary to give a new name to the Cockatoo which I have heretofore erroneously called *Ducorpsii*, and figured under that name in the 'Proceedings' for 1862. I propose, therefore, to call it *Cacatua ophthalmica*, as its most distinguishing characteristic when living is the blue naked skin which surrounds the eye, and renders it at first sight distinguishable from every other bird of the genus.

Before giving the specific characters of this new species, I may remark that the White Cockatoos, of the genus *Cacatua*, may be divided into two very easily distinguished sections. The first embraces those species which have a narrow medial head-crest, with the slender point recurved at the extremity, and appearing above the surface of the adjoining feathers when the crest is in a state of repose. The second contains those species which have the crest broadened and comprising the greater part of the head-feathers, rising when erect into a sphere more or less pyramidal in shape, but showing when in a state of repose no recurved point. The following diagnoses may assist in determining the species :—

Sect. A. *Crista angustata ad apicem recurva.*

Majores candidæ, crista flava	{ 1. <i>galerita</i> , ex Australia.
Minores candidæ, crista aurantiaca...	{ 2. <i>triton</i> , ex Nov. Guinea et Molucc.
	{ 3. <i>citrinocristata</i> , ex Timor.
crista flava	{ 4. <i>sulphurea</i> , ex Timor, Flores, Lombock et Celebes.
	{ 5. <i>æquatorialis</i> , ex Nov. Guin. et Molucc.
Major, crista tricolore	{ 6. <i>Leadbeateri</i> , ex Australia.

Sect. B. *Crista lata incumbente.*

Candida major; crista alba	7. <i>cristata</i> , ex Ternate.
crista rubra	8. <i>moluccensis</i> , ex Ceram, Batchian et Ternate.
crista limonacea ...	9. <i>ophthalmica</i> , ex ins. Salomon.
minor; crista alba, intus limonaceo tincta ...	10. <i>Ducorpsii</i> , ex ins. Salomon.
genis rubro tinctis ..	11. <i>sanguinea</i> , ex Australia.
crisso rubro	12. <i>Philippinarum</i> , ex ins. Philipp.
Rosacea	13. <i>roseicapilla</i> , ex Australia.

The new species may be shortly characterized as follows :—

CACATUA OPHTHALMICA, sp. nov.

Cacatua Ducorpsii, Selater, P. Z. S. 1862, p. 141, pl. xiv.

Alba : *cristæ plumis elongatis, intus pallide limonaceis* : *subalaribus et caudæ tectricibus inferioribus limonaceo tinctis* : *rostro et pedibus nigris* : *annulo oculari in ave viva cæruleo* : *crassitie vix minore quam in Cacatua cristata.*

Hab. In ins. Salomon.

In conclusion I may remark that the Society's living series of Cockatoos contains examples of nine out of the thirteen known species, the deficiencies being only four, namely, *C. triton*, *C. sulphurea*, *C. sanguinea*, and *C. Philippinarum*.

MISCELLANEOUS.

Salmo cambricus.

To the Editors of the Annals and Magazine of Natural History.

GENTLEMEN,—I find that the name of *Salmo cambricus*, which I have given to the Charr of Llanberris Lake, has been previously used by Donovan for the Sewin of Wales. Therefore, to prevent confusion, I propose to change the name of the former species into *Salmo Perisii*.

I remain, Gentlemen,
Your obedient Servant,
A. GÜNTHER.

British Museum, Nov. 28, 1864.

On the Cetacea of the French Mediterranean Coasts.

By M. PAUL GERVAIS.

After some remarks on the necessity of studying the osteological characters in discriminating the species of Cetaceans, M. Gervais states that he has been able to ascertain the existence on the French coasts of the Mediterranean of nine species of those animals, belonging to nearly as many genera. Upon these species he makes the following observations:—

1. THE CACHALOT (*Physeter macrocephalus*).—This species is very rare, the occasional reported occurrence of individuals generally referring to large species of Delphinidæ. A true Cachalot was taken in 1856, by the fishermen of Saint Nazaire; and a considerable portion of its lower jaw is preserved in the collection of the Marist Fathers, at La Seyne, near Toulon.

2. THE ZIPHIUS (*Ziphius cavirostris*, Cuv.).—This species, long regarded as fossil, really exists in the Mediterranean; the specimen of which the skull was described by Cuvier (*Rech. Ossem. foss.*) was found by the fishermen of the Gulf of Bouc. Others have since been obtained, and each of them has been described as a new species—*Delphinus Desmarestii*, Risso (taken at Nice), *D. Philippii*, Cocco (Straits of Messina), *Hyperoodon Doumetii*, Gray (Corsica), and *H. Gervaisii*, Duvernoy (Aresquiès).

3. THE GRAMPUS (*Orca gladiator*).—This species has only twice been captured. One was taken about twenty-five years ago at Cète; its dental formula was $\frac{1}{1}\frac{1}{2}$. Another came ashore at Elne (Pyrénées orientales) in 1857; but its lower jaw (the only fragment preserved) contains only ten teeth, so that M. Gervais does not feel sure of its being of the same species as the Cète specimen. It is also impossible to say whether it may be identical with the *Delphinus Feres*.

4. THE ROUND-HEADED PORPOISE (*Globiceps*).—The names *Delphinus melas*, *D. deductor*, and *D. globiceps* have been given to a large oceanic species, the type of the genus *Globiceps* of Gray. Similar species, if not mere varieties, have been brought from the south coast of the United States, from Guadaloupe, New Zealand, and the Japanese seas.

But it is doubtful whether this species exists in the Mediterranean. The genus *Globiceps* has been recognized by M. Gervais in some Delphinidæ of 14–17 feet long, of which a shoal of about fifteen ran on shore in the neighbourhood of Barcarès (Pyrénées orientales) in February 1864. Four of these specimens reached M. Gervais, and he compared the skeleton of one of them with different skeletons of *G. melas* in the Museum of Paris. The only differences that can be pointed out reside in the curvature of the incisive bones, and in the somewhat more obtuse appearance of the teeth; but equivalent differences also occur between the specimens of *Globiceps* from other seas when carefully compared, so as, to a certain extent, to justify the supposed species which have been admitted in this genus by authors. The Mediterranean *Globiceps* thus appears to constitute a new race, if not a new species. Like the Cetacea of this genus which live in the ocean, it has the head much inflated, and the muzzle short; and its colour is black, except beneath, where it presents a large median band commencing in the form of a heart near the throat, and extending to the anus.

5. **RISSE'S PORPOISE** (*Grampus Rissoanus*).—G. Cuvier has described this species, which is very nearly allied to his *Delphinus griseus*; but the former lives in the Mediterranean, the latter on the coasts of Brittany. The cranium of this species presents characters which are easily recognized. The Museum of Paris possesses two skulls from specimens taken at Nice by Risso and Laurillard; there is another in the Museum of Marseilles obtained from one of a shoal which came into Carry (Bouches-du-Rhône) two years ago.

6. **THE BOTTLE-NOSED DOLPHIN** (*Tursiops Tursio*).—This is not so rare as the preceding species, but far less common than the *Delphinus Delphis*. M. Gervais has specimens taken in the Gulf of Lyons, especially at Cette and La Nouvelle and at Gruissau.

7. **THE COMMON DOLPHIN** (*Delphinus Delphis*).—This is the stationary Dolphin of the coasts. One of its chief distinctive marks consists in the widened double groove on the face of its palate. This double groove is visible after the removal of the membrane of the palate; it does not exist in the *D. Tethyos* of Gervais.

8. **DOLPHIN OF TETHYS** (*Delphinus Tethyos*).—Of this the author knows only two individuals—one taken at the mouth of the Orb (Hérault) in 1852, the other in the vicinity of Port-Vendres (Pyrénées orientales), of which the skull is in the collection of Dr. Pinchinat.

9. **THE RORQUAL** (*Rorqualus antiquorum*).—This great Cetacean exhibits the same characters in the Mediterranean as in the ocean; it is the *Mysticetos* of Aristotle. It is seen from time to time on the French coasts, especially those of the Pyrénées orientales and the Var. In 1862 a female, with her young, remained for more than a month chiefly in the small bay of Paulilles, Port-Vendres, and Collioure. This was perhaps the Cetacean which, some months later, ran on shore at the rocks of Borro, on the Spanish coast, and was towed to Llanza, where M. Gervais saw it.

Such Cetaceans rarely run aground on the sandy shores of Lan-

guedoc and La Camargue; but the great whale with a channelled belly, mentioned by Daléchamp as having come ashore in his time near Montpellier, must be regarded as a Rorqual, and the jaws of this species preserved at Frontignan have probably a similar origin.

M. Gervais records, as specimens which have grounded during more recent periods, one, 17 feet long, of which the skeleton is in the museum of Perpignan; a larger one, taken at Saint-Cyprien, described by Farines and Carcassonne as *Balænoptera aragous*; that of Saint-Tropez in 1833; those of the île Sainte-Marguerite, one in 1797, described by Lacépède and Cuvier, the other in 1864; and two or three others taken near Toulon, of which the skulls or entire skeletons have been preserved.—*Comptes Rendus*, Nov. 28, 1864, p. 876.

Descriptions of some new Fishes. By Prof. KNER.

The fishes described by Professor Kner were collected by Dr. E. Gräffe on the private expeditions fitted out by MM. J. C. Godeffroy & Son, of Hamburg.

Family Labroidæ.

THYSANOCEILUS, nov. gen.

Char. gen. Ambo labia margine fimbriato, dentes acuti uniseriales supra et infra, in medio ossis intermaxillaris 4, inframaxillaris 2 dentes canini, 2 quoque supra ad oris angulum; totum caput, labiis exceptis, squamis minutis tectum, nec non guttur penitus clausum ad isthmum usque; trunci squamæ magnæ; linea lateralis continua, simplex; pinnæ ventrales in filum prolongatæ, caudalis rotundata.

Thysanocheilus ornatus.

T. color universalis nigrescens, ad abdominis latera albicans; truncus et fere omnes pinnæ lineis et punctis cyaneis obsitæ. D. 7/12. A. 3/10. Sq. long. 28, vertic. 15-16.

From Upolu (Navigator's or Samoa Islands). Catal. no. 791. Most nearly allied to *Labrichthys cyanotænia*, Bleek. (Atlas, i. tab. 22. fig. 1); but in this the lower lip only is fringed, and there is only one canine in the upper jaw, at the angle of the mouth; it also wants the complete union and scaling of the sides of the throat; and the colour and form of the head differ.

Family Squalidæ.

LEIUS, nov. gen.

Char. gen. Rostrum obtusum, modice productum; dentes supra-maxillares parvi, acuti, pluriseriales et mobiles, inframaxillares numero 26, uniseriales, lati, apice medio prælongo, in laminam immobilem coaliti, antrorsum spectantes; foramina temporalia semilunaria; pinnæ parvæ et inermes, prima dorsalis anali opposita et secundæ vicina, analis nulla; cutis læviuscula; fissuræ branchiales 5, parvæ.

Leius ferox.

L. capitis longitudo ad primam usque fissuram branchialem $5\frac{1}{2}$ in

longitudine totali ; anus intra pinnas ventrales situs ; lobus pinnæ caudalis superior late truncatus ; colore obscure brunneus.

From Australia. Catal. no. 239. Certainly related to *Scymnus* and *Læmargus*, but is quite distinct from *S. bispinosus*, Q. & G. (Voy. Uranie, Atlas, Zool. pl. 44) and also from *Somniosus brevipinna*, Less.

The following species are described as probably new :—

Cottus gigas, perhaps identical with *C. jaok*, Cuv. & Val., or a variety of that species. From Decastre's Bay, at the mouth of the Amur. Cat. no. 1395.

Osmerus oligodon, very near *O. japonicus*, Brevoort (Japan. Fishes, pl. 10), but readily distinguished by its lateral line being interrupted as in *O. eperlanus*. From the same locality as the preceding species.—*Sitzungsber. der Akad. der Wiss. zu Wien*, Nov. 10, 1864, p. 185.

Observations on the Structure of the Nervous System in Clepsine.

By E. BAUDELQT.

In its totality the nervous chain of *Clepsine* appears to be organized on the same type as in the other Hirudineæ. Above the mouth there is a bilobed, cerebroid, inflated part, giving origin to two very short connectives which closely embrace the œsophagus and unite the cerebral with the subœsophageal centre ; the latter is voluminous, and is followed by a series of twenty-one very distinct ganglia united by double connectives, and the chain terminates in an elongated nervous mass, the extremity of which corresponds with the centre of the posterior sucker.

When one of the ganglia of the median portion of the chain is examined by the microscope, two sorts of elements are easily distinguished through its hyaline membrane—some fibrous, the others cellular. The fibrous portion appears as a median ribbon continuous with the connectives, and becomes gradually enlarged towards the middle of the ganglion, acquiring at this part a fusiform or lozenge-shaped appearance. At the level of the angles of this lozenge the lateral nerves originate. The cellular portion of the ganglion consists of six capsular inflations, of an ovoid form : two of these are situated on the median line beneath the fibrous median ribbon, through which they may be seen ; the other four occupy each one of the compartments of the ganglion.

These six capsules appear to contain only unipolar cells, the dimensions of which vary between $\frac{2}{100}$ and $\frac{4}{100}$ mill. Each of these cells contains a large nucleus, of oval form, with one or more nucleoli in its interior. The cells of the four exterior capsules are continuous by their produced extremity with a nervous fibre ; all the fibres which thus originate radiate towards the centre of the ganglion, where they interlace either with the fibres from the opposite capsules or with those which descend from the connectives and lateral nerves.

The connectives appear to consist of a fibro-granular substance

without distinct nervous fibres. In the space between each pair of connectives is a very delicate nervous bundle, apparently of the same substance as the connectives: this represents the intermediate nerve described by E. Faivre in the common Leech.

The subœsophageal inflation is of large size as compared with the other ganglia; it is somewhat triangular in form; its truncated apex is continuous with the ganglionic chains; its concave base embraces the lower surface of the œsophagus; and its antero-lateral angles are continuous with the cerebral connectives.

On the margins of this fibro-nervous mass is arranged a series of capsules or inflations, formed of unipolar cells perfectly similar to those of the ventral ganglia; in the median line there is also a double series of eight or ten similar capsules. By counting these capsules, we find that, as each simple ganglion contains six of them, the sub-œsophageal ganglion is formed by the union of at least four ganglia, which are confounded together by the extreme shortness of their connectives. The caudal inflation presents a very similar arrangement of parts; by the same mode of calculation it appears to result from the fusion of at least seven ganglia.

The cerebrum exhibits nothing to differentiate it from the other ganglia: it consists of a fibro-nervous loop continuous with the connectives and passing over the œsophagus, and bearing on its margin on each side six capsules containing unipolar cells. From their direction a certain number of fibres originating from these cells seem to bear towards the median line, and to pass from one side to the other. Thus the cerebrum may be regarded as consisting of two simple ganglia.

The lateral nerves (two in number) originate from each side of their ganglion; at their origin they are united in a common sheath of fibro-elastic tissue, but they soon separate. After a short course (about 1 millim.) the anterior branch usually presents on one side a small ganglionic inflation, often exceeding $\frac{1}{10}$ millim. in size; this, which is sometimes fusiform, sometimes quadrangular, consists of a granular material, in which is a large oval nucleus, usually furnished with several nucleoli. It commonly gives off a short branch, which unites the anterior with the posterior root; when the inflation is quadrangular, each of its angles emits a nervous branch.

Another very interesting peculiarity consists in the existence of nervous cells appended here and there, like grapes, to the most delicate extremities of the lateral nerves. These cells, which are usually unipolar, measure from $\frac{2}{100}$ to $\frac{3}{100}$ millim.; they contain a granular matter enclosing an oval nucleus with one or more nucleoli.

As to the signification of these cells, the author says: "Brandt indicated in the Leech a gastric system, which other skilful observers were subsequently unable to discover. In 1857, Faivre discovered in the stomachal membrane of the Leech a network formed of nervous tubes and cells—a network the existence of which is certain, but of which he could not ascertain the connexions. Now, from the facts that I have ascertained with regard to *Clepsine*, I am convinced that this nervous network is formed at the expense of the terminal

extremities of the lateral nerves, and that it is the analogue of the stomato-gastric of other Annelides, from which it differs only in its origin. This, moreover, is not without precedent in science. M. de Quatrefages, in his investigations of the Annelides, has shown that in *Eunice sanguinea*, for example, the visceral nervous system furnishes the nerves both of animal and vegetative life."—*Comptes Rendus*, Nov. 14, 1864, p. 825.

On Ptychochærus plicifrons (Centuriosus pleiceps, Gray).

By Dr. L. J. FITZINGER.

The recorded species of the family *Setigera*, according to Dr. Fitzinger, are nineteen in number, and form seven distinct genera, namely, *Sus* with nine, *Potamochærus* with two, *Porcula* with two, *Ptychochærus* with one, *Phacochærus* with two, and *Dicotyles* with two species.

Dr. Fitzinger proposes the name of *Ptychochærus plicifrons* for the Pig described by Dr. Gray under the name of *Centuriosus pleiceps*, and gives the following as the characters of the genus:—

"Fore and hind feet with four toes; skin wrinkled, divided on the body by deep regular folds into three belts, and very sparingly clothed with scattered bristles. Snout elongated into a short, moveable, very broad trunk, truncated in front, which projects beyond the lower lip. Ears very large and broad, rounded, flattened, and hanging down loosely at the sides of the head. Tail not very short, terminating in a tuft. Incisors, canines, and molars present in both jaws; molars simple. No lobes of skin or wart-like elevations on the cheeks. Upper canines not penetrating the snout. No secretory glands at the posterior part of the back. Teats situated on the belly and groin. Stomach simple.

"Dental formula as in the genus *Sus* : $\frac{6}{6} \cdot \frac{1-1}{1-1} \cdot \frac{7-7}{7-7} = 44$."

This Pig has only been discovered about three years, and is only known in the domesticated state. It has been imperfectly noticed by Bartlett and Gray. Dr. Fitzinger describes it from living specimens in the Zoological Garden at Vienna. He also rejects the previous supposititious statements of the native country of this remarkable form of Pig, which is said to be China or Japan, his reason for so doing being that no travellers in those countries have ever mentioned its occurrence there, nor does its portrait appear among the numerous figures of animals that we possess drawn by Chinese and Japanese artists. Dr. Fitzinger thinks it probable that Abyssinia is the native country of the species; and in support of his view he quotes a short notice by Dr. Theodor von Heuglin of a similar form, called "Hassama" by the Abyssinians, which occurs wild among the mountains of Simehn. Heuglin's note is as follows:—"This species is somewhat smaller than our European Wild Swine, strongly covered with bristles, dark blackish brown, spotted with greyish yellow; the head is short and obtuse; the ears are very long and pendent, and the litter always small.—*Sitzungsb. der Akad. der Wiss. zu Wien*, Nov. 10, 1864, p. 181.

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XI.—*Carcinological Gleanings*.—No. I.

By C. SPENCE BATE, F.R.S. &c.

[Plate I.]

A SYSTEMATIC series of dredgings of the coasts of the Shetland Islands having been determined on by the British Association, the carrying out of the labour was entrusted to a committee.

The object with which the dredgings were undertaken was to ascertain the relative distribution in the sea of the Mollusca. It was therefore with the zeal of true naturalists that, while collecting the shells, the committee provided for the preservation of other animals.

It is by this means, chiefly through the kindness of Mr. Jeffreys, that a tolerably fair collection of Crustacea from this locality has found its way into my possession. Among them are a few Diastylidæ that have not hitherto, as I believe, been described.

They consist of two species of the genus *Diastylis* (to which I have added a third from a still more northern locality) and one of a genus that is new to science. This last is certainly a very remarkable Crustacean. Unfortunately, it is not perfect, being deficient of the four last segments of the pleon. The preserved parts indicate an intermediate position between the true Diastylidæ and the Mysidæ.

Diastylis echinatus. Plate I. fig. 1.

Carapace about one-third the entire length of the animal, and as deep as half its length. The extremities of the antero-lateral projections meet above anteriorly, and are elevated slightly upwards into a short rostrum, serrated dorsally and anteriorly and tipped with a stout spine.

A serrated ridge traverses the antero-lateral margin sub-
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parallel with the edge of the carapace. A second serrated corrugation is situated a little behind the first, one-half of which is subparallel with the dorsal surface; the other half lies at a right angle to it, and is subparallel with the anterior margin of the carapace, and corresponds somewhat with the direction of the first ridge, but extends to less than half its length. The angle formed by the two lines is surmounted by a strong spine; a similar spine marks the centre of each divergent line.

Situated still posteriorly is a third serrated ridge. It originates near the centre of the median dorsal line, and appears to repeat the second line, that is, it traverses first a line diagonally produced anteriorly, and then suddenly bends at an angle that is rather less than a right angle; proceeding downwards and backwards, it terminates in a semicircular bend. Lower down (that is, nearer to the lateral margin) this semicircular serrated ridge is twice repeated, the anterior of which, from its position, appears to correspond with the line of the second ridge, of which it may be an imperfect continuation. The third ridge, like the second, has the angle that is made by its change of direction tipped with a strong spine: a similar spine stands near the middle of the upper half; but the lower half is not so marked. A strong spine occupies the centre of the dorsal line at the point where the third ridge meets the one upon the opposite side. Two other somewhat stronger spines occupy the median line posteriorly to the one mentioned, and a third, much smaller, stands upon the extreme limit of the posterior margin of the carapace. Two spines on each side, subequally distant from each other and the central, also stand upon the posterior margin; and the carapace is armed all over with subequidistantly placed, short, stout spines.

The eye is situated in a deep notch in the median line corresponding with the anterior point of the second serrated ridge. Behind, near the median line, but on each side of it, are two closely placed small spines, and still further back in the median line are two strong spines, subequally distant from each other and from the organ of vision.

The pereion has four somites exposed behind the carapace, the first of which is narrow, and narrows laterally until it is lost beneath the carapace; it is serrated along the anterior margin, and armed on the dorsal median line with a short strong spine. The second somite is broader than the first, and increases in width towards the lateral extremities. The dorsal median line is crowned by a central spine that is longer than that on the first, and a small lateral spine or tooth that is planted close but slightly anterior to it; the anterior margin, for about half the extent of the somite, is slightly serrated.

The third somite is slightly broader than the second, and, like it, increases a little in width towards the lateral edge, but curves backwards instead of forwards. The anterior margin is smooth, and the dorsal median line is furnished with a central spine and a small lateral one placed a little anteriorly to it.

The posterior somite is broader still than the preceding, and increases in extent laterally to nearly two-thirds of its depth, where it is produced both anteriorly and posteriorly into a prominent tooth, after which it suddenly decreases to the margin; dorsally it is armed in the median line with a strong tooth, and laterally with one that is longer and less robust.

The pleon is as long as the pereion and cephalon together, and therefore half the length of the animal. The first somite is rather deeper than long, and armed upon the dorsal surface with a central upright tooth. The second somite is proportioned like the first, but is furnished with two, parallel, submedian, vertical teeth. The third and fourth are similar to the second; but the teeth gradually decrease posteriorly. The fifth somite is much longer on the ventral than on the dorsal surface; the dorsal spines are attached to the posterior ridge, and anteriorly directed. The sixth is a little longer than broad, and unarmed. The telson is nearly three times as long as the sixth somite of the pleon, and posteriorly serrated along the dorsal surface.

The superior antennæ are not visible in the perfect animal; the inferior project a little beyond the extremity of the rostrum. The first pair of pereiopoda are long and powerful, projecting to some distance beyond the extremity of the inferior antennæ. The second are shorter, and terminate in a few hairs. The three last are uniform, and about the same length as the second; they are curved anteriorly, and have the coxæ short and as broad as the somites of the pereion to which they respectively belong. The bases are long; the ischia are short; the mera and carpi are moderately long and subequal. The propodi are very small and short, and the dactyli are long and pointed.

The first five somites of the pereion are not furnished with appendages in our specimen. We have therefore little doubt that it is a female. The sixth somite is furnished at the postero-inferior angles with a pair of pleopoda, of which the peduncle is nearly three times as long as the somite to which it is an appendage; the rami are rather more than half the length of the peduncle, and terminate in styliiform points. The telson is as long as the peduncle of the caudal pleopoda, and narrows ventrally after it has passed the terminal outlet of the alimentary canal.

The length of the animal is about half an inch. It was taken

by the dredge, in the summer before last, at the Shetlands; but Mr. Jeffreys, from whom I received it, has not recorded the exact position or depth at which it was taken.

Diastylis bicornis. Pl. I. fig. 2.

The carapace is less than a third of the length of the animal, and pointed in front to a blunt rostrum. It is furnished laterally upon each side, in a line with the dorsal eye, with a small anteriorly projecting tooth, behind and a little outside of which is a second much larger tooth, which, together with the one upon the opposite side of the carapace, gives the double-horned character to the species, from which the name is derived. In the posterior or cardiac region of the carapace, a little on each side of the median line, is a small spine. The lateral walls or branchial regions are thickly studded with small pointed teeth or spines, planted in short rows in a direction vertical to the lateral margins, the spines becoming more feeble and ultimately dying out as they approach towards the dorsal surface. These spines are all directed forwards, and are most abundant as well as most important in size near the hepatic region, anterior to which they again diminish in proportion.

The pereion exposes dorsally four perfect somites posterior to the carapace, of which the posterior is the longest. All are smooth and free from ornamentation.

The pleon is long and slender, the first somite being nearly as long as broad; the second, third, and fourth each gradually increase in length, and are all furnished near the postero-lateral extremity with a few cilia. The fifth somite is still narrower and longer; the sixth is as long as the fifth, but increases in breadth posteriorly to furnish points for the articulation of the posterior pair of pleopoda.

The telson is long and narrow, being lanceolate and tipped with a long process that is ciliated upon each side.

The eye is small, and dorsally placed. The antennæ are small, or supposed to be so, since they are not discernible in our unique specimen. The first pair of pereiopoda reach to some distance beyond the extremity of the rostrum. The last three pairs are uniform in shape and size, and terminate in pointed but not very powerful dactyli and a few corresponding cilia.

The pleon in our specimen is not supplied with appendages; and the entire animal is about half an inch in length.

It was dredged with the preceding; but neither the exact locality in the Shetlands nor the depth at which it was taken has been recorded.

Diastylis borealis. Pl. I. fig. 3.

The carapace is much deeper anteriorly than it is posteriorly; the antero-lateral processes of the mandibular segment do not meet on the dorsum, but form two distinct arcuate margins. The infero-anterior margin is strongly serrated. The rostrum is short and blunt at the extremity. The anterior surface of the carapace is ornamented with several short spines, placed in rows, that traverse a direction coinciding somewhat with that of the anterior margin. The posterior portion of the surface possesses a reticulated appearance, owing apparently to the cellular structure of the tissue. The margins of the exposed segments of the pereion are smooth, and the last is produced posteriorly into a strong tooth.

The antennæ are short; the superior do not extend beyond the extremity of the rostrum, the peduncle being shorter and broader than the flagellum. It carries four cilia—two on the terminal articulus and one on each of the others. The inferior antennæ are longer than the upper, and consist of a peduncle, of which only two joints are exposed. The flagellum consists of six articuli, of which the first is the shortest, the second is the longest, and the remaining four gradually decrease in length towards the extremity; a small secondary appendage, consisting of two or three articuli, is attached to the extremity of the peduncle.

The appendages attached to the first and second somites of the pleon of the male are bifurcate at the extremity. The third and fourth somites have two pairs of strong hairs corresponding in position to the appendages in the two previous somites; the fifth somite is without appendages or hairs, and is half as long again as the preceding. The sixth somite is about the same in length as the fifth, and terminates laterally in two long appendages (pleopoda), the basal joint of which is rather more than twice the length of the sixth somite, and is furnished with spines on the inner side: at the extremity of the basal joint are two subequal rami; the inner is furnished with a series of spines on the inner margin, corresponding to and continuous with those upon the basal joint. The outer ramus is clean and slightly longer, and terminates in several cilia, which, by their close approximation, generally make the outer ramus appear longer than the inner. The telson reaches to about the extremity of the basal joint of the terminal pleopoda, and terminates bluntly, and is furnished with four or five spines or stiff hairs, similar to those on the inner margins of the pleopoda. Length of animal rather more than half an inch.

The specimen from which this description is taken was brought up from a depth of 10 to 15 fathoms, in Port Kennedy, by

Dr. Walker, who obtained it during Sir F. L. M'Clintock's last Arctic expedition. It is preserved in the Dublin Museum.

I take this to be the same as the smaller specimen figured by Professor Thomas Bell in his account of the Arctic Crustacea brought home by Sir Edward Belcher, and supposed by him to be either a male or immature specimen of *Diastylis* (*Alauna*) *Goodsiri*, although they "differ in some characters, as the less convex form of the carapace, more obvious rugæ on the fore part of it, and the existence of an acute point on each side of the last leg-bearing" somite.

From this the specimen now described differs in such minute points as may be only errors in figuring, or at most minor variability in individual character—as, for instance, the apparently less regularity of the rows of small spines on the anterior surface of the carapace, and the serrated condition of the antero-inferior margin of the carapace.

I must also allude to the remarkable circumstance of a secondary appendage being attached to the inferior pair of antennæ in this specimen, which I have never seen or known of its having been observed in any of the genera. Undoubtedly it homologizes with the squamiform appendage attached to the third joint of the inferior antennæ of the Macrurous Decapods, and is consequently the homotype of the secondary appendage so common to the superior antennæ of Crustacea in all orders, and to which in our present specimen it bears some considerable resemblance. In the inferior antennæ the peduncle normally consists of five joints; but in this the organ assimilates to the character of the superior antennæ. Thus we perceive that the two joints usually existing beyond the secondary appendage are here reduced to the condition of those inferior joints which we describe as articali.

This condition of the antennæ in this group of Crustacea demonstrates very forcibly the depauperized character of the animals—a circumstance that suggests the probable liability to some more or less variation in those organs which have suffered depreciation from the normal type, but are essential to the welfare of the existence of the animal. It is under such considerations as these that I am led to the belief that impoverished appendages such as these antennæ are can have but little diagnostic importance in the determination of specific characters.

NANNASTACUS*, nov. gen.

The anterior somite of the carapace is separated from the posterior by a distinct suture. The antero-lateral extremities of

* *Νάννος*, dwarf; *ἄστακός*, marine crab.

the posterior portion of the carapace do not extend so far anteriorly as the rostrum, and do not meet in front. The pereion has four somites exposed posteriorly to the carapace. The eyes are sessile, and situated one on each side. The pereiopoda have the seven joints normally developed, and support a secondary appendage. The four last somites of the pleon, with the telson, are wanting; therefore the form of the posterior pair of pleopoda and of the telson are not known.

Nannastacus binoculoides. Pl. I. fig. 4.

The anterior portion of the carapace is centrally elevated in the stomachal region, and crested by two parallel longitudinal rows of small beadlike tubercles. It is depressed centrally and elevated anteriorly and laterally, forming three conspicuous lobes: the anterior is an obtuse rostrum, rounded above, and covered with minute tubercles; the lateral lobes correspond with and support the organs of vision. The posterior division of the carapace is anteriorly produced laterally and inferiorly beyond the eyes. The infero-lateral margin not only ascends, but meets the anterior margin of the lateral processes at a right angle, the point of meeting being anteriorly produced into a sharp denticle. The posterior margin of the carapace is thickened into a strong and elevated ridge, which is dorsally crested with strong tubercles. The first two exposed somites of the pereion are very short, and are crested dorsally with fine tubercles. The third and fourth somites are longer than the first two, but they are also narrower, and have the dorsal tubercles more prominent than those on the preceding. Posterior to these are the only three somites of the pleon that are known; these are scarcely longer than broad, and are dorsally furnished with crests of small tubercles.

The characters of the posterior pairs of pleopoda and telson are unknown.

The eyes are small, sessile, and situated one on the centre of a lobe on each side of the head. The antennæ and organs of the mouth I have not been able to determine, from a reluctance to dissect a unique specimen.

The second pair of gnathopoda assimilate closely in form to those of the first pair of pereiopoda in the normal *Diastylis*, and extend anteriorly in front of the carapace to some distance. The first four pairs of pereiopoda have the coxæ small, and armed with tubercles; the bases are long and broad, and the remaining joints developed upon the type of true Macrurous Decapoda, terminating in sharp well-developed dactyli.

The last pair of pereiopoda differ from the preceding in having the coxa very reduced in size, and the basis narrowed to slender proportions. A secondary appendage consists of a strong

basal joint, equalling in length the basis of the pereopod, and a terminal flagellum formed of many minute articuli, each of which supports strong cilia.

The entire animal is ornamented with numerous closely packed minute tubercles or coarse granules. They are most abundant, but least conspicuous, on the carapace, where they appear to culminate on the dorsal median line, being largest on the posterior ridge of the anterior somites of the pleon; they increase on the dorsal surface into short spines; the coxæ and bases of the four anterior pairs of pereopoda are also conspicuously granulated.

This little Crustacean, which is about the eighth of an inch in length, differs from the true *Diastylidæ* in several important particulars, all of which distinctions conduce to the opinion that it stands in the animal kingdom at a grade higher, or, to speak more correctly, in a position nearer to the true *Macrura*.

It will be seen that the eyes are two, and separated widely apart; but they differ from the *Macrurous* type in being sessile and attached to the anterior portion of the carapace: in this respect they differ from the same organs in the true *Macrura*, since those are pedunculated, and, even in the larval condition, exist as free organs independent of, though closely protected by, the tissues of the carapace.

In all the *Diastylidæ* that have been hitherto described, the antero-lateral processes of the posterior portion of the carapace pass before and meet in front of the anterior portion of the carapace, enclosing it so as to bring it near the centre of the carapace. In the animal now described these lateral processes reach but little beyond the eyes; but we see, as it were, an effort to fulfil the same conditions in the prolongation of the inferior angle beyond the superior, whereas in the *Macrurous* type this is considerably rounded off.

It is to be regretted that this solitary specimen has alone been obtained from the numerous dredgings on the coast of Shetland; but it is to be hoped that, since now attention is drawn to the creature, we may be able to obtain more of an animal which, from its intermediate character, may offer in dissection conditions of considerable interest, that may assist in unravelling the mystery of some of the lost parts of certain fossil Crustacea.

EXPLANATION OF PLATE I.

Fig. 1. *Diastylis echinatus*.

Fig. 2. *Diastylis bicornis*.

Fig. 3. *Diastylis borealis*.

Fig. 3 k. First pair of pereopoda.

Fig. 4. *Nannastacus binoculoides* (lateral view).

Fig. 4". The same (dorsal view).

XII.—*Fourth Account of new Species of Snakes in the Collection of the British Museum.* By ALBERT GÜNTHER, M.A., M.D., Ph.D.

[Plates II. & III.]

THE following species of Ophidians have been added to the Collection of the British Museum since the publication of the last paper on the same subject in this Journal (November 1863, p. 348). The total number of species in that collection amounts now to 789, and that of the typical specimens to 289.

In the following lists some of the species are marked with an asterisk (*): they will be described in this paper.

I. *List of Species which were formerly desiderata.*

- Calamaria leucogaster*, *Blkr.*, = *C. Rebentischii*, *Blkr.* Sumatra, Sinkawang. Dr. P. Bleeker. (Typical specimens.)
 — *monochrous*, *Blkr.* Sumatra. Dr. P. Bleeker. (Typical specimen.)
 — *borneensis*, *Blkr.* Sintang. Dr. P. Bleeker. (Typical specimen.)
 — *Roelandti*, *Blkr.* Borneo. Dr. P. Bleeker. (Typical specimen.)
 — *margaritophora*, *Blkr.* Sumatra. Dr. P. Bleeker. (Typical specimen.)
 — *agamensis*, *Blkr.*, = *C. Dumerilii*, *Blkr.*, = *C. Sinkawangensis*, *Blkr.* Sumatra, Sinkawang. Dr. P. Bleeker. (Typical specimens.)
Prosymna meleagris, *Rhrdt.* Valley of the Shiré. Purchased.
 **Polemon Barthii*, *Jan.* Old Calabar. Purchased.
Uriechis capensis (*Elapomorphus capensis*, *Smith*). Caffre-land. Sir A. Smith. (Typical specimen.)
Ablabes decemlineatus, *D. & B.* Palestine. Rev. H. B. Tristram.
Coluber lineaticollis, *Cope.* Dueñas. Messrs. Godman & Salvin.
Mastigophis lateralis, *Hallowell.* California. Purchased.
Dromicus portoricensis, *Rhrdt.* —? A. Günther.
Gonyosoma Jansenii, *Blkr.* Manado. Dr. P. Bleeker.
Psammodon oxyrhynchus, *Rhrdt.* Pungo Andongo. Dr. Welwitsch.
Dipsas variegata, *Rhrdt.* West Africa. Purchased.
 — *obtusa*, *Reuss.* Egypt. Rev. O. P. Cambridge.
 — *gemmistrata*, *Cope.* Pacific Coast of Guatemala. O. Salvin, Esq.
Tropidonotus semicinctus, *D. & B.* —? Dr. P. Bleeker.
Ogmodon vitianus, *Peters.* Feejee Islands. A. Günther.
Vermicella Bertholdi, *Jan.* Swan River. Purchased.
 **Brachyuropsis australis*, *Kreff.* Clarence River. G. Krefft, Esq.
Naja mossambica, *Peters.* Zambesi River. Dr. Kirk.
Cerastes caudalis, *Smith.* West Africa. Dr. Welwitsch.

Clotho (*Vipera*) *euphratica*, *Martin*. Galilee. Rev. H. B. Tristram.
 — *atropoides*, *Smith*. Cape of Good Hope. Sir A. Smith.
 (Typical specimen.)

II. *List of the new Species procured and described in the course of the year 1864.*

**Calamaria flaviceps*. Borneo.

Rhynchocalamus melanocephalus. Palestine. Rev. H. B. Tristram.

**Oligodon Waandersii*. Boni. Dr. P. Bleeker.

**Simotes vertebralis*. Bandjermassing. L. L. Dillwyn, Esq., M.P.

Coronella nototaenia. Zambesi. Dr. Kirk.

Cyclophis nasalis. Southern India. A. Günther.

**Megablades olivaceus*. Manado. Dr. P. Bleeker.

**Coluber batjanensis*. Batjan. Dr. P. Bleeker.

**Spilotes megalolepis*. South America. Purchased.

**Dromicus Godmanni*. Dueñas. Messrs. Godman & Salvin.

**Ahaetulla frenata*. — ? A. Günther.

**Psammophis trigrammus*. River S. Nicolao. F. F. Monteiro, Esq.

Chamæ tortus aulicus. Zambesi. Dr. Kirk.

**Tropidonotus sundanensis*. Sumatra. Dr. P. Bleeker.

**Limnophis bicolor*. Angola. M. B. du Bocage.

**Dendraspis Welwitschii*. Golungo Alto. Dr. Welwitsch.

* — *polylepis*. Zambesi River. Dr. Kirk.

* — *intermedius*. Zambesi River. Dr. Meller.

Calamaria flaviceps.

Calamaria Schlegelii, Günth. Colubr. Snak. p. 5 (not Dum. & Bibr.).

Upper labial shields five; first pair of lower labials not forming a suture together; an azygos scale between the chin-shields. Head two-thirds as broad as long. Blackish brown, with rings of white dots across the back, each ring corresponding to a white space on the belly; these dots are very obscure, and may entirely disappear in old examples. Belly with black cross bands. Head entirely uniform yellow. Ventral shields 152; subcaudals 20–23.

Borneo.

Polemon Barthii.

We received lately a snake from Old Calabar which agrees so well with *Polemon Barthii*, Jan, that no doubt can be entertained as to their specific identity. Its dentition is opisthognathous, as has been shown by Prof. Peters (Monatsber. Acad. Wiss. Berl. 1863, p. 368). Ventral shields 205, anal divided, subcaudals 18. But, most singularly, *the subcaudals are divided*, and not simple as in the typical specimen.

Simple subcaudals are justly generally considered as a generic character; but it appears that on the West Coast of Africa,

where snakes with simple subcaudals are more common than anywhere else, there exist Ophidians which offer exceptions to the general rule. In my last paper on Ophidians (Ann. Nat. Hist. 1863, p. 363) I have made the remark that Reinhardt's typical specimen of *Atractaspis irregularis* is described as having *scutella*, whilst all the following writers attribute simple *scuta* to this species. A specimen which Dr. Welwitsch brought from Angola has the five anterior subcaudals entire, and the posterior seventeen divided; so that the character of simple subcaudals is evidently subject to variation in the genus *Atractaspis*. Bibron has made a similar observation in *Leptodira rufescens*, which induced him to name the genus which he founded upon it *Heterurus*. Therefore there is no reason why I should not consider the specimen mentioned above as identical with *Polemon Barthii*.

Thus the question arises whether *Uriechis*, Peters, *Microsoma*, Jan, = *Urobelus*, Rhrdt., *Polemon*, Jan, and *Miodon*, Dum., should not be referred to one and the same genus. Peters thinks that *Polemon* is a good genus, characterized by the articulation of the maxillary and os pterygoideum externum by means of a *double* process; but the materials are at present much too scanty to decide whether this character by itself is of generic value or not. Nay, when we consider that only a few examples of those snakes have been examined, that several of them are young, that Jan's assertion of *Microsoma* having a simple nasal shield is contradicted by Reinhardt, who found two in *Urobelus*, we are justified in recommending caution as regards the adoption of the several species which have been proposed as distinct.

Oligodon Waandersii.

Scales in fifteen rows; ventrals 151, anal bifid, subcaudals 28. Upper labials six, the third and fourth entering the orbit; one præ-, two post-oculars; temporals 1 + 2. Upper parts brownish olive, with pairs of yellowish spots, edged with blackish, along the back; head and neck with the markings characteristic of this genus. Lower parts uniform white.

The young has the spots more distinct, of a bright yellow colour; there are about twelve pairs from the nape to the extremity of the tail.

We have received two specimens from Dr. Bleeker: the larger is $8\frac{1}{2}$ inches long, and has been named by him *Rhabdion Waandersii*; the younger, 4 inches long, *R. cruciatum*. They are from Boni.

Simotes vertebralis.

Scales in fifteen rows. Upper labials seven, the third and fourth entering the orbit; loreal square; one ante-, two post-

oculars; temporals 1 + 2; ventrals 154; anal entire; subcaudals 54. Brownish grey above, with a series of twenty-two equidistant orange-coloured spots along the vertebral line, each as large as two scales, and edged with black; the first, on the nape, is elongate, band-like; many scales on the side have an orange or black edge. Head with the markings usual in this genus. Lower parts uniform yellowish.

This is the only species I know which has only fifteen rows of scales, like some *Oligodontes*; however, the teeth on the palate are very distinct, although few in number. The specimen is from Bandjermassing, and is 14 inches long, the tail having a length of 3 inches.

MEGABLABES.

Body rather elongate and slender; head of moderate size, rather depressed, with a flat crown. Two nasals; one loreal; two anterior and two posterior oculars. Scales smooth, without apical groove, elongate on the anterior parts of the trunk, and square posteriorly. Ventrals rounded, about 200; anal entire; subcaudals two-rowed. Eye rather large. The maxillary teeth form a continuous series, and gradually increase in length posteriorly, none of them being grooved.

This genus forms a connecting link between the Coronelline and Colubrine snakes: it might be considered as a gigantic *Ablabes* with the physiognomy of a *Herpetodryas*, with the dentition of *Ptyas*, and with an entire anal shield; and, on the other hand, the unusually small number of scales distinguishes it from all the other true Colubrine genera.

Megablabe olivaceus.

Rostral shield much broader than high, obtusely rounded above, just reaching to the upper surface of the head; anterior frontals nearly square, half as large as the posterior, which are about as broad as long. Vertical much longer than broad, with the lateral edges concave, and the posterior edges short and meeting at an obtuse angle. Superciliaries large, as large as the vertical, with a prominent orbital edge. Occipitals obtusely rounded behind, as long as the vertical and one-half of the posterior frontals. Loreal rather longer than high. The præ-orbital is concave, extending to the upper surface of the head, but not reaching the vertical; there is a small second præ-orbital below the larger one. Two postoculars; eight upper labials: the first enters the margin of the nasal opening, which is very wide, the fourth and fifth coming into the orbit; the sixth triangular, the point being directed upwards; the seventh is the largest, oblong. Temporals 2 + 2, both anterior in con-

tact with the postoculars. Two pairs of chin-shields, the posterior of which are much longer than the anterior, and divergent. Ventrals 197; subcaudals 102.

The upper parts, and from the middle of the length of the trunk the lower ones, are brownish black; anterior part of the belly yellow; some scales of the vertebral series of the foremost part of the trunk brownish yellow. The two outer series of scales of the anterior half of the trunk yellowish; but a series of irregular black blotches runs along the lower part of the sides, to the point where the dark colour becomes generally predominant.

We have received one example of this interesting snake from Dr. Bleeker's collection as *Leptophis olivaceus*; it comes from Manado, and is 78 inches long, the length of the tail being 20 inches, and that of the head $1\frac{1}{4}$ inch.

Coluber (Lielaphis) batjanensis. Pl. II. fig. A.

Body and tail moderately elongate, but slightly compressed. Head depressed; eye small. Rostral shield broader than high, reaching to the upper surface of the head; anterior frontals not quite one-third as large as the posterior; vertical pentagonal, longer than broad, its lateral edges being rather shorter than the anterior. Occipitals as long as the vertical and posterior frontals together, slightly divergent behind. Nostril rather wide, dividing the two nasals. Loreal longer than high, half as large as the single anteocular, which extends upwards just to the upper surface of the head; two postoculars; eight upper labials, the third, fourth, and fifth entering the orbit; temporals 2 + 2 + 3. Scales short, rounded, without apical groove, smooth, in seventeen series. Ventral shields 236; anal entire; subcaudals 78. Each maxillary with about twelve teeth, subequal in length.

Upper parts brownish black; head brownish olive; anterior part of the trunk with rather indistinct triangular reddish spots along each side, their point being directed upwards; each scale of the outer series with a small reddish spot near the apex. Ventral shields brownish yellow, with the lateral corners black.

Total length 61 inches; tail 12 inches.

Spilotes megalolepis.

As *Spilotes Salvini* differs from *S. variabilis* in having much smaller scales, so the present species is distinguished by very large scales; they form fourteen series only, those of the outer series being very small, whilst all the others are very large, lanceolate, and provided with a strong, broad keel; the largest of the scales are as large as, or larger than, an occipital shield.

The form of the head and of the shields is the same as in *S. variabilis* and *S. Salvini*, the sixth upper labial being very small, and the seventh very large. Ventral plates 226; anal entire; (tail mutilated).

Black; snout with two lighter cross bands; upper labials brownish yellow, with broad black margins; anterior ventrals yellow, with a black margin, which gradually becomes broader in the ventrals of the second fifth of the length of the body; from the middle of the length, the belly and the subcaudals are entirely black.

Total length 7 feet 9 inches.

Dromicus Godmanni.

Scales smooth, without apical groove, in twenty-one series; ventrals 176; anal divided; subcaudals 88. Loreal longer than high; one præ-, two post-oculars. Upper labials eight, the fourth and fifth entering the orbit. Temporals 1+2+3. Posterior chin-shields shorter than the anterior, which are in contact with four lower labials. Brownish grey, with a blackish vertebral band as broad as a scale; another similar band runs along the fifth outer series of scales. Dark lines, besides, follow each of the other series of scales. Each upper labial with a bright-yellow, dark-edged spot; a pair of yellow spots on each side of the neck, at the commencement of the lateral band. Lower parts uniform whitish.

Several specimens were collected by Messrs. Godman and Salvin at Dueñas (Guatemala): the largest is 18 inches long; tail 5 inches.

Ahatulla frenata. Pl. II. fig. B.

Of very slender habit. Scales smooth, lanceolate, in seventeen rows. Snout produced, rather pointed, the width of the interorbital space being only two-thirds of the length of the snout. Anterior frontals not quite twice as long as broad; posterior frontals twice as long as broad. Loreal none; præ-orbital reaching to the upper surface of the head, but not in contact with the vertical; two postorbitals. Rostral shield quite at the lower surface of the projecting part of the snout. Eight upper labials, the third, fourth, and fifth entering the orbit. Temporals 1+2+2. Eye of moderate size, with round pupil. Ventral shields long, not keeled on the sides, 191 in number; anal bifid; subcaudals 166. The posterior maxillary tooth is somewhat larger than, and separated from, the preceding tooth, and not grooved. Upper parts of the head and nape green; a black, inferiorly white, streak runs from the rostral shield through the eye, along the side of the head and neck, as far backwards as the seventh ventral shield. The trunk and the

tail, below as well as above, are greyish, punctulated and finely marbled with purplish; a few small irregular black spots are sparingly scattered over the back, sides, and belly.

Total length 52 inches; length of head $\frac{5}{8}$ inch; length of tail 22 inches.

The native country of this species is not known.

Psammophis trigrammus. Pl. II. fig. E.

Head and anterior part of the trunk uniform greenish olive, which colour gradually passes into the reddish olive of the remainder of the trunk and of the tail. Behind the anterior third of the length of the trunk the scales of the vertebral series begin to show a black extremity; and these spots are confluent into a narrow black streak on the tail. A series of indistinct brown spots runs along the meeting halves of the two outer series of scales of the posterior two-thirds of the trunk and of the tail. Ventral shields and the outer half of the outer series of scales yellow; ventral shields tinged with greenish in the middle.

Scales in seventeen rows; ventrals 182; anal bifid; subcaudals 134. Snout moderately elongate, not pointed. Vertical shield contracted in the middle, as generally in *Psammophis*; loreal much elongate; one ante-, two post-oculars; nine upper labials, the fifth and sixth entering the orbit. Posterior chin-shields much longer and narrower than the anterior.

One specimen, 4 feet long (tail 17 inches), was obtained by Mr. Monteiro on the banks of the river S. Nicolao (Little Fish Bay, West Africa). It has so many points of resemblance to *Chrysopelea præornata* that I hesitated for some time to describe it as distinct. However, it is undoubtedly a true *Psammophis*, having one of the middle maxillary teeth much enlarged; the corresponding tooth in our specimens of *C. præornata* (which are young) is but little larger than the others. Both snakes appear, at all events, to be specifically distinct, differing in the number of the scales and upper labials, in the form of the head-shields, and in the coloration of the anterior parts; but it is not improbable that *C. præornata* would be better referred to the genus *Psammophis*.

Tropidonotus sundanensis. Pl. II. fig. D.

Scales in nineteen rows, strongly keeled, lanceolate. Head not depressed; eye very large, the length of its diameter being scarcely less than that of the snout. Anterior frontals subtruncated in front; rostral rather broader than high; vertical broadest in front, with the lateral margins convergent, much longer than broad; occipitals rather longer than the vertical,

rounded behind. Loreal as high as long. One antecular, concave, extending to the upper surface of the head, but not reaching the vertical; three very narrow postoculars; nine upper labials, the fourth, fifth, and sixth of which enter the orbit. Temporals 1 or 2 + 3. Chin-shields elongate, the posterior much longer than the anterior, and divergent. Ventrals 146; anal divided; subcaudals 96. The last maxillary tooth is larger than, and separated from, the others.

Upper parts greenish olive, with two series of black spots along the vertebral line, and with another series along each side near the belly; the spots of the latter series are largest anteriorly, where they partly extend on to the ventral shields. Crown of the head with black dots symmetrically arranged; labial shields with a black hinder edge; each ventral with a narrow black streak across its base, interrupted in the middle.

This snake, which we received with the above name from Dr. Bleeker's collection, is from Siboga (Sumatra). The specimen is 32 inches long, the tail being 11 inches long.

LIMNOPHIS, nov. gen. (Fam. Natricidæ.)

Habit stout, cylindrical; form of the head as in *Tropidonotus*; tail rather short. Scales smooth, short, in nineteen rows; anal and subcaudals divided. A single anterior and two posterior frontals; loreal present. Maxillary teeth in an uninterrupted series, gradually increasing in size posteriorly, the last being distinctly larger than the preceding, and not grooved.

Limnophis bicolor. Pl. II. fig. C.

This species is very similar to *Neusterophis levissima*, Gthr., a genus to which it stands in the same relation as *Astretium* to *Tropidonotus*. The single anterior frontal is triangular, rather longer than broad; posterior frontals small, scarcely larger than the anterior. Vertical more than twice as long as broad, with parallel outer edges, and with a right angle behind; occipitals as long as the vertical and posterior frontals together, rounded behind. Nostril between two nasals, lateral, a little directed upwards; loreal large; one præocular, extending to the upper surface of the head, but not reaching the vertical; two postoculars; eight upper labials, of which the third and fourth, or the fourth alone, enter the orbit; the sixth and seventh are the largest, and the sixth is in contact with the occipital, which is bent downwards. Temporals 1 + 2, none in contact with the postoculars. Chin-shields two pairs, elongate; the posterior much divergent behind, and longer than the anterior. Ventrals 132; anal 1/1; subcaudals 45. All the upper parts uniform black; belly white.

M. Barboza du Bocage has sent us two specimens, which came from the province Duque de Bragance (Angola). Total length 24 inches; tail 4 inches.

Brachyuropis australis.

Mr. Krefft has kindly sent us a specimen of the snake described by him as *Simotes australis*. Finding it very similar in its physiognomy to *Brachyuropis semifasciata*, which I described and figured in this Journal (January 1863), I re-examined the latter, and am enabled by their comparison to correct several errors.

1. Both species are congeneric, readily distinguished by their coloration and by the scales, which are more elongate in *B. australis*. The dentition of *Brachyuropis*, which had been injured in the larger specimen of *B. semifasciata*, but which is perfect in *B. australis*, has been erroneously described as opisthoglyphous; the grooved tooth, on the contrary, is the foremost of the maxillary bone, although placed far backwards on the side; two very small teeth occupy the posterior extremity of the maxillary. Therefore *Brachyuropis* is to be placed in the family of *Elapidæ*, near *Furina*.

2. The typical specimen of *Brachyuropis semifasciata* and one of *Neelaps calonotus* were obtained from a collector who had been sent to New Granada, and who stated that they had been collected by himself in that country. Hence I was led to doubt Duméril's statement that the latter species is a native of Tasmania. But now, having received a species closely allied to *B. semifasciata* from Australia, it appears to be almost certain that that collector bought those specimens on his return in England, and that the two species named are really from Tasmania.

DENDRASPIS, Schleg.

Two species of this genus were known, viz. *D. angusticeps* and *D. Jamesonii*. I am enabled to add three others from the collections made by the members of the Zambesi expedition and by Dr. Welwitsch. The species will be readily distinguished by the following diagnoses.

Dendraspis Jamesonii, Traill.

Scales in thirteen rows; ventral shields 220. The last upper labial shield is not in contact with the upper temporal.

Dendraspis Welwitschii. Pl. III. fig. A.

Scales in fifteen rows. Ventrals 213; anal bifid; subcaudals 107. Seven upper labial shields, the fourth of which enters the orbit, the sixth being the largest. There is only one large

temporal shield, which is in contact with the second upper post-orbital. Three large shield-like scales behind the occipitals. Dull brownish green; each scale on the front part of the trunk with a black tip. Scales and shields of the tail with a narrow black margin.

Total length 64 inches; tail 15 inches.

One specimen has been obtained by Dr. Welwitsch in Golungo Alto, a district in Angola.

Dendraspis angusticeps, Smith. Pl. III. fig. B.

Scales in seventeen or nineteen rows; ventrals 226-270. Two very large anterior temporals, the upper of which extends as far backwards as the occipital.

Southern and Western Africa.

Dendraspis intermedius. Pl. III. fig. C.

Scales in nineteen rows; ventrals 206; subcaudals 112. Upper labials eight, the sixth being the largest, the seventh and eighth small; temporals 2+3; both anterior temporals in contact with the postoculars, and not extending as far backwards as the occipitals. Uniform green, with a few scattered yellowish spots. Inside of the mouth white.

One specimen, 55 inches long, tail 13 inches, was received from the Zambesi River.

Dendraspis polylepis. Pl. III. fig. D.

Günth. Proc. Zool. Soc. June 28, 1864.

Scales in twenty-three rows; ventrals 258; subcaudals 120. Temporals 2+3; both anterior temporals in contact with the postoculars. Dull greenish olive; hind part of the body and tail with small irregular blackish spots; inside of the mouth black.

Zambesi.

XIII.—On the Genera and Species of British Echinodermata.

By the Rev. ALFRED MERLE NORMAN, M.A.

PART I.

CRINOIDEA—OPHIUROIDEA—ASTEROIDEA.

TWENTY-FOUR years is a long period in the history of our knowledge of any class in the animal kingdom; and such is the time which has elapsed since our latest and, indeed, only monograph on British Starfishes was published; and Prof. Forbes's work still remains our only authority on the subject. In the interim, however, not only has very much been learnt respecting the

anatomy, physiology, and reproduction of the Echinodermata, which is beyond the scope of the present paper, but not a few memoirs have appeared on the Continent which have thrown additional light on the general organization and arrangement of these animals; and the writings of Agassiz, Sars, Lütken, Von Düben, Koren, J. Müller, Troschel, Gray, Forbes (subsequent papers), Grube, Dujardin, and Hupé, &c., bear testimony to the great need there is of a complete revision of the nomenclature and classification of the Echinodermata which inhabit the British seas. Such a revision is the more required because at the time when Professor Forbes wrote his monograph the laws of zoological nomenclature were not so fully recognized as they are at the present day, and thus a later name was frequently applied to a species while the author was fully conscious that the animal had been described under another name at an earlier date.

For some time past we have been urged by friends interested in the study of the Echinodermata to prepare such a revision, the want of which has been very generally felt. In the following paper we will attempt to do so. The object which we shall have in view is fourfold: 1st, to revise the nomenclature of the species described in the 'History of British Starfishes,' and redistribute them in the genera now generally recognized; 2ndly, to give the characters of all the orders, families, and genera; 3rdly, to describe all those species which have been discovered in our seas since the publication of Forbes's work, or which require to be redescribed in order that they may be more readily distinguished from certain allied forms now incorporated in our lists; 4thly, to give some information as to the geographical distribution of the species.

Among the Echinodermata which will be here introduced as supplemental to those of Forbes's work are many which have not hitherto been published as British, though some of them have been mentioned as additions to our fauna, and exhibited by the author at recent meetings of the British Association.

We have adopted a plan with respect to the synonymy which will at once show the reader why we have employed the name which is here given to the species. The dates prefixed to the references, and the brief notes here and there appended to them, will in most cases, without any paragraph-observations, suffice to render obvious the causes of any change in nomenclature which may have been made. We have given as few references as are consistent with the end to be attained. To writers of earlier date than Forbes we have only referred when it was necessary to establish the date of a name. The synonymy quoted from more recent writers is intended to show what authors first introduced any particular change of name, or, in some cases,

have best described and perhaps figured the species. With respect to the species more recently introduced into our list of Echinodermata, such references to other works are given as were thought likely to be of service to the student.

Specimens have been examined by the author from every British locality which is given for the rarer species, unless the name of the locality is inserted between inverted commas.

The following is necessary to explain the measurements employed:—The “lesser radius” is a line drawn from the centre of the disk to its edge, between two of the arms; and the “greater radius” is the distance from the centre of the disk to the extremity of an arm. Similarly, the “lesser diameter” is the width across the disk; and the “greater diameter” the measurement from tip to tip of the arms.

The second part of this paper, on the *Echinoidea* and *Holothuroidea*, will, we hope, be illustrated by figures of the spicula of the species of the last-named most difficult order. The author will be much obliged to any naturalists who will send to him for examination any Holothuroidea which they may think of interest; and it would be a great assistance should any reader of these notes be able to inform him where the type, or, indeed, any specimens are to be found of the following species—*Psolinus brevis*, *Cucumaria fusiformis*, *C. fucicola*, *C. Drummondii*, *C. Montagu*, *C. Neillii*, *C. dissimilis*, *Thyone Portlockii*,—or British specimens of *Holothuria intestinalis* and *H. tubulosa*.

It only remains to conclude these introductory remarks by returning our sincere thanks to the friends who have so kindly assisted us in various ways while collecting information and preparing this paper. Our acknowledgments are more especially due to Mr. Alder, Prof. Wyville Thompson, Mr. Jeffreys, Dr. E. Percival Wright, Mr. Patterson, Mr. Hodge, Mr. T. Edward, and Mr. D. Robertson.

Class *ECHINODERMATA*.

Order I. CRINOIDEA.

Body pentagonal or round, more or less conical, either sessile and adherent by the aboral surface or supported (sometimes, as in *Antedon*, only in the young state, and then free in the adult) on a multiarticulate, solid, calcareous peduncular column of great length, the base of which is firmly cemented to foreign bodies. Arms five, solid, multiarticulate, proceeding from the aboral and inferior surface, dichotomously branched from near the base, and frequently again and again subdivided; ultimately pinnate; not furnished with any spines, but having numerous marginal tentacula. Aboral and inferior side of body formed by

the basal joints of the arms united with a calyx-shaped base, which is composed either of a single calcareous piece or of numerous angulated plates closely cemented together. Mouth and anus both superior, and distinct from each other. Respiration (in *Antedon*) chiefly effected by means of the tentacula which fringe the sides of the arms and pinnules, and the ciliated surface of channels which traverse the upper side of the arms. No madreporiform tubercle. Sexes distinct. Ovaries externally conspicuous, attached to the sides of the pinnules or ultimate subdivisions of the arms.

Fam. *Antedonidæ*.

Young animal cemented to stones, shells, or sea-weed by a multiarticulate peduncle of considerable length, originating from the aboral and inferior calyx-formed side of the body. Adult animal free (a separation having taken place at the junction of the peduncle with the calyx), having the calyx furnished with numerous many-jointed and clawed cirrhi, by means of which it clings at will to *Laminariæ* or other bodies. Arms bifurcating close to the base, beneath the surface of the body, and in some foreign species again and again subdivided; composed of joints which are transversely somewhat wedge-formed, so that they are alternately wider on either side of the arms; each such joint on its wider side gives support to a multi-articulate pinnule. Oral surface of the body covered with a thin membranous skin.

Genus I. *ANTEDON*, Fréminville.

[*Antedon*, Fréminville, 1811; *Alecto*, Leach, 1815; *Comatula*, Lamarck, 1816.]

Mouth central. Anus lateral. Calyx or aboral surface composed of a single piece, with which the five radial plates of the base of the arms articulate. Arms with two or three basal joints, after which they bifurcate, and in some foreign species are subsequently a second and even third time subdivided.

We feel that we have no choice. The name of *Antedon* must be employed in preference to that of *Comatula*. Fréminville's genus has five years' precedence over that of Lamarck, and was thus clearly defined (Bull. Soc. Philomatique de Paris, vol. ii. 1811, p. 349):—"Animal libre, à corps discoïde, calcaire en dessus, gélatineux en dessous, environné de deux rangs de rayons articulés, pierreux, percés dans leur largeur d'un trou central; ceux du rang supérieur plus courts, simples et d'égale grosseur dans toute leur longueur; ceux du rang inférieur plus longs, allant en diminuant de la base à la pointe, et garnis dans toute leur longueur d'appendices alternes également articulés;

bouche inférieure et centrale;” and he refers to the figure in the “Encyclopédie Méthodique,” pl. 124. fig. 6, which represents “*Comatula rosacea*” or a closely allied species. Justice, therefore, and the laws of nomenclature compel us to adopt Fréminville’s genus. Had *Comatula* obtained universal acceptance, usage might have been pleaded in its favour; but it has no such claim. J. Müller, the chief authority on the family, has adopted Leach’s genus *Alecto* (Archiv für Naturgeschichte’ for 1841 and 1843); and in this he has been followed by most, if not all, of the Scandinavian writers. *Alecto*, however, was constituted subsequently to *Antedon*; and, moreover, if it were employed among the Crinoidea, the same name applied to a genus established in 1821 by Lamouroux for a section of the Polyzoa, and which has been generally received, would require to be superseded.

Antedon rosaceus (Linck).

1828. *Comatula rosacea*, Fleming, Hist. British Animals, p. 490.

1841. *Comatula rosacea*, Forbes, British Starfishes, p. 5.

1844. *Alecto Petasus*, Von Düben and Koren, Öfversigt af Skandinaviens Echinodermes, Kongl. Vetensk. Akad. Handl. p. 229, pl. 6. fig. 1.

1848. *Antedon decameros*, Gray, Brit. Mus. Cat. Brit. Radiata, p. 28.

“Perisom of the disk naked, or with scattered tubercles containing groups of radiating calcareous spicules. Centro-dorsal plate convex, flattened at the apex, its sides covered with dorsal cirrhi; but the central flattened portion, of greater or less extent, naked. Cirrhi 14–18-jointed; the joints short, the longest but little longer than broad. Terminal claw sharp and curved; penultimate joint with a short pointed opposing tubercle, which is not developed into a claw. Proximal pairs of pinnules at least twice as long as those succeeding. Ovaries short and rounded. Usually, when mature, without any trace of interradial plates (specimens from Arran, N. B., Strangford Lough, Ilfracombe, Kirkwall Bay, and generally round the coast); frequently, however, with groups, usually of three, perisomatic interradial plates in the spaces between the radial axillaries (specimens from Plymouth, Shetland, &c.). Colour crimson, scarlet, or mottled. Average size $4\frac{1}{2}$ inches from tip to tip of the arms.”

Antedon Milleri (J. Müller).

1821. *Comatula fimbriata*, Miller, Nat. Hist. of Crinoidea, p. 132 and frontispiece (but not *C. fimbriata*, Lamarck).

1849. *Comatula Milleri*, Johannes Müller, Ueber die Gattung *Comatula*, Lam., und ihre Arten.

“Perisom of the disk with scattered warts, supported by groups of diverging spicules. Centro-dorsal plate uniformly convex and entirely covered with dorsal cirrhi. Cirrhi of from fifteen

to eighteen joints; the longest of the joints about once and a half as long as broad. Terminal claw curved and acute; penultimate joint without a trace of an opposing process. Proximal pinnules greatly longer than those succeeding them. Ovaries narrow and long, extending over more than half the length of the pinnules. Groups of interrarial plates occupying the spaces between the radial axillaries. Of a rich brown or reddish-tawny colour. Average size 11 inches from tip to tip of the arms. This fine species is somewhat intermediate in its characters between *C. rosacea* and *C. Eschrichtii* (J. Müller). Arran, N. B., Belfast (Prof. Wyville Thompson); mouth of the Mersey (Dr. Walker)."

Professor Wyville Thompson and Dr. Carpenter, during the investigations into the anatomy and physiology of this genus, on which they have for some time been engaged, have discovered the above species, which has hitherto been confounded with *A. rosaceus*. The preceding descriptions of the two species have been most kindly supplied to us for insertion by Professor Wyville Thompson; and we cannot sufficiently thank him for the liberality with which he has foregone all personal considerations in his readiness to aid in making the present paper a complete record of British Echinodermata.

The synonymy of the two species will be extremely difficult to unravel; and the names, which are here adopted, may, perhaps, hereafter have to be changed.

Antedon Sarsii (Düben & Koren).

1844. *Alecto Sarsii*, Von Düben & Koren, Öfversigt af Skandinaviens Echinodermter, Kongl. Vetensk. Acad. Handl. p. 231, pl. 6. fig. 2.
 1860. *Comatula Sarsii*, Alder, Ann. Nat. Hist. ser. 3. vol. v. p. 74, pl. 5. fig. 2.
 1862. *Comatula Sarsii*, Dujardin & Hupé, Hist. Nat. des Zoophytes Echinodermes, p. 199.

Perisom of the disk naked or with scattered calcareous granules. Centro-dorsal plate conical, covered in every part with dorsal cirrhi. Cirrhi 13-20-jointed; the joints dice-box-formed, or of much smaller diameter in the centre than at the extremities, produced, the longest three or four times as long as broad; terminal claw acute; penultimate joint with a claw opposing the terminal claw, and nearly half its size. Three or four proximal pinnules greatly longer than those succeeding them. No interrarial plates. Colour dusky brown.

This Norwegian species was first added to the British fauna by my late friend Mr. Barlee, who procured a single fragmentary specimen at Shetland, as recorded by Mr. Alder in the 'Annals of Natural History,' Feb. 1860. In 1861 we dredged it

living gregariously in about 90 fathoms water, forty miles east of the Whalsey Skerries, Shetland. It is, however, apparently extremely local, as, during two summers' dredging on the Shetland Haaf, it was only met with on this one occasion.

Antedon Celticus (Barrett).

1857. *Comatula Woodwardii*, Barrett, Ann. Nat. Hist. 2nd ser. vol. xix. p. 33, pl. 7. fig. 1 (*but not C. Woodwardii*, E. Forbes, *Palæont. Trans.* 1852, *Radiaria of the Crag*).

1857. *Comatula celtica*, Barrett, Ann. Nat. Hist. 2nd ser. vol. xx. p. 44.

Arms long and tapering, each ray bearing from sixty to seventy pinnæ on each side. The two pinnæ nearest the disk have each twenty-seven joints; the third, and those above it, eighteen. Each pinna is separated by two joints. The larger filiform processes (cirrhi) are composed of forty-five joints, gradually tapering, terminated by a claw which is larger than the joint next to it.

The above is a transcript of the late Mr. Barrett's description. Two specimens (the only examples as yet known) were dredged by Mr. M'Andrew in the Sound of Skye, in 25–40 fathoms, on a bottom of gravel and mud. This is a very fine *Antedon*, and very distinct from the other British species.

Order II. OPHIUROIDEA.

Body round or slightly pentagonal, depressed, having five or rarely six long arms inserted on, and proceeding from, the oral surface, but not continuous with the disk. Arms very slender and flexible, having a central vertebra-like framework, often encased in scales, and always bearing spines. Reptation by means of the flexible arms and their spines. Mouth inferior, central. Viscera not prolonged into the arms. No special anal opening, the digested matter being rejected through the oral aperture. Respiration effected by means of membranous tentacula issuing from the lower surface of the arms and the ciliated epithelium of the inner surface of the body and arms. No eyes. No pedicellariæ. No respiratory pores on the aboral surface. Madreporiform tubercle sometimes present, sometimes absent (in adult); when present, situated in one of the interradian spaces on the inferior or oral surface of the disk. Reproductive organs opening by ten apertures (twenty in some exotic genera) on the oral surface near the base of the arms.

Fam. I. *Astrophytonidæ*.

Arms generally ramose, but sometimes undivided; not plated with distinct series of scales. Two radiating rib-like projections

on the aboral surface of the disk, over the origin of each arm. No interradiial plates (in the British genera) in the inferior interbrachial spaces.

Genus II. ASTROPHYTON, Linck.

Disk thick, pentagonal or round. Arms five, dichotomous from near the base, the branches again and again subdividing, until each arm terminates in innumerable very slender, filamentous branchlets. Under surface of arms with a transverse row of short spines to each joint, some of the spines provided with hook-formed processes. No interradiial plates. Ovarian apertures ten, two in each interbrachial space. Oral plates bordered with spine-like papillæ, which increase in length towards the mouth.

Astrophyton Linckii, Müller & Troschel.

1733. *Astrophyton scutatum*, Linck, de Stellis marinis, *part.*, pl. 19. no. 48.

1766. *Asterias caput-Medusæ*, Linn. Syst. Nat. 1101, *part.*

1777. *Astrophyton arborescens*, Pennant, Brit. Zool. vol. iv. p. 67. no. 73
(but not of *Rondeletius* nor of *Müller and Troschel*).

1842. *Astrophyton Linckii*, Müller & Troschel, Syst. der Asteriden, p. 122.

Astrophyton Linckii is confined to the seas of Scandinavia and Shetland. We believe that it has not been procured in the latter locality since the publication of Forbes's work. In our dredgings to the east and north of the Shetland group, we have not seen a trace of the species; and the fishermen, to whom we showed Forbes's figure, were unacquainted with it. It would seem, therefore, that the species is only to be found on the western side of the islands. Dr. Charlton has kindly given us the following information respecting the *Astrophyton* which he procured:—"As far as I can recollect, my specimen of the *Astrophyton* was obtained on the north-western coast of Shetland; but, as it is twenty-nine years ago, I am not certain; for I did not get it myself, but it was procured by William Cameron, Esq., of Belmont, in Unst, who died about twenty-five years ago. The specimen was very large and fine, and in very perfect condition. In those days the fishermen knew it well; and I almost think, if my memory deceives me not, that I saw in 1852, twenty years after my first visit, a small specimen at the 'buidie' at Stennis, in Northmavine."

Genus III. ASTERONYX, Müller & Troschel.

Disk pentagonal, naked, without scales or granules; two radiating ribs over the origin of each arm. Arms long and slender, undivided, without scales, convex above, flat beneath. Spines in transverse rows, the larger furnished with hooked processes. No interradiial plates. Oral plates bordered with papil-

lary spines on the margin, increasing in length and size towards the mouth, being most developed on the maxillary face. Ovarian apertures ten. A madreporiform tubercle in one of the interradial spaces on the oral surface.

Asteronyx Lovéni, Müller & Troschel.

1842. *Asteronyx Lovéni*, Müller & Troschel, Syst. der Asteriden, p. 296.
 1861. *Asteronyx Lovéni*, Stewart, Ann. Nat. Hist. vol. viii. p. 77 and fig.
 1861. *Asteronyx Lovéni*, Sars, Oversigt af Norges Echinodermer, p. 5, pl. 1. figs. 1-5.
 1862. *Asteronyx Lovéni*, Dujardin & Hupé, Hist. Nat. des Zoophytes Echinodermes, p. 296.

Disk pentagonal, covered, as are also the arms, by a naked skin, wholly devoid of scales or granules; a pair of flat cartilaginous radiating ribs on the dorsal surface over the base of each arm. Arms very long (greater to lesser radius as about 18 to 1), convex above, flat beneath. Spines very short, originating from calcareous elevated processes; the number of spines in each transverse row (contrary to what is the rule among the Ophiuridæ) is less at the base of the arms than at some little distance from the margin of the disk; the greatest number of spines in any transverse row is twelve; one spine in each row is much longer than the rest, and more than equal in length to half the breadth of the arm; this spine is inclined inwards and covered with a smooth skin, but towards the apex it is furnished with several hook-formed processes. There are no papillary spines over the tentacular pores. The oral aperture is bounded by five strong calcareous bars, one of which forms the inner margin of each interradial space.

A single specimen is all that has as yet been found to prove the existence of this fine Norwegian Echinoderm in the British seas. That specimen, which is a fine example, measuring in its lesser diameter $1\frac{5}{8}$ inch, and in its greater diameter 2 feet, is now preserved in the British Museum. It was procured from Loch Torridon, in Rosshire, in the summer of 1859, by Mr. John A. Stewart, who took it from the deep-sea lines, which had been set in a part of the loch 9 fathoms deep, where the bottom was rocky. The occurrence of the species in the Laminarian Zone is somewhat remarkable, since on the Norwegian coast, like the *Astrophytonidæ* in general, it inhabits the deep sea in from 50 to 150 fathoms.

Fam. II. Ophiuridæ.

Arms always simple, and (in British genera) always encased by four series of scales, one dorsal, one ventral, and two lateral. No radiating ribs on the dorsal surface of the disk over the origin of the arms; generally two radiating scales take their place, but

in some genera these are wholly absent. Interradial plates of greater or less size always present.

Genus IV. OPHIOTHRIX, Müller & Troschel, 1840.

Disk not scaly, covered with more or less developed spines and spinose tubercles, and having two very large, triangular radiating scales above the origin of the arms. Arms simple, scaly; superior scales imbricated; lateral carinated, bearing long, elegantly serrated, spreading spines. Interradial plates very small. Oral plates with plain sides.

Ophiothrix fragilis (O. F. Müller).

1789. *Asterias fragilis*, Müller, Zool. Dan. vol. iii. p. 28, pl. 98.

1841. *Ophiocoma rosula*, Forbes, Brit. Starfishes, p. 60.

1842. *Ophiothrix fragilis*, Müll. & Trosch. Syst. der Asteriden, p. 110, pl. 9. fig. 2.

1845. *Ophiothrix rosula*, Forbes, Trans. Linn. Soc. vol. xix. p. 151.

1841. *Ophiocoma minuta*, Forbes, Brit. Starfishes, p. 65 (*the young*).

Found all round our coast, and ranging from the Mediterranean to Norway and Finmark.

Genus V. AMPHIURA, Forbes, 1842.

Disk scaly, generally having six larger scales in the form of a rosette at the centre; scales smooth, or bearing scattered small spines; two, usually narrow, radiating scales above the origin of the arms. Arms simple, scaly; lateral scales carinated, bearing simple (or rarely anchor-headed) spreading spines. Interradial plates small. Oral plates with plain sides.

Amphiura filiformis (O. F. Müller).

1841. *Ophiocoma filiformis*, Forbes, Brit. Starfishes, p. 40.

1857. *Amphiura filiformis*, Sars, Bidrag til Kundsk. om Middlehavets Litt. Fauna, p. 84.

1858. *Amphiura filiformis*, Lütken, Addit. ad hist. Ophiuridarum, Förste Afdeling, p. 56, pl. 2. fig. 11.

Disk covered with small scales, not having any larger than the rest in the centre; radiating scales narrow, subparallel; under surface of disk membranous, and nearly devoid of scaly covering. Arms extremely long and very slender: spines 5-7 on each lateral plate; one of them anchor-headed. No papillary spines over the tentacular pores.

Shetland; Firth of Clyde; Durham and Northumberland coasts (Norman). "Killary and other marine loughs of Connemara" (Forbes).

Amphiura Chiajii, Forbes.

1841. *Ophiocoma punctata*, Forbes, Brit. Starfishes, p. 37 (*the young?*).

1845. *Amphiura Chiaiïi*, Forbes, Trans. Linn. Soc. vol. xix. p. 151, pl. 14. figs. 14-18.
 1857. *Amphiura Chiaiïi*, Sars, Bidrag til Kundsk. om Middlehavets Littoral-Fauna, p. 86, pl. 1. figs. 8-10.
 1858. *Amphiura Chiagei*, Lütken, Addit. ad hist. Ophiuridarum, Förste Afdeling, p. 57, pl. 2. fig. 12.
 1862. *Amphiura Chiaiïi*, Dujardin & Hupé, Histoire Naturelle des Zoophytes Echinodermes, p. 253.

Disk covered with small scales, and having a central and five surrounding scales in the form of a rosette, larger than the rest; radiating scales triangular, diverging; under surface of disk not membranous, closely covered with scales of similar character to those of the upper surface. Arms extremely long and very slender; spines 4-6 (rarely 7) on each lateral plate, all of them simple. Two papillary spines to each tentacular pore.

This species ranges from the Ægean to the Scandinavian seas, and on our own coast is far more common than either *A. filiformis* or *A. brachiata*, with both of which, however, it has frequently been confounded. Like *A. filiformis*, it inhabits mud in the coralline zone; and not unfrequently the two species are found in company. Judging from Forbes's description and figure, we are inclined to regard his *Ophiocoma punctata* as the young of the present species. Forbes's type specimen was presented to the British Museum, but would appear to have been lost. The tablet which we found to be marked "*Ophiocoma punctata*," and which bears on its back a little label in Forbes's own handwriting, has mounted upon it, instead of the type *Ophiocoma punctata*, a specimen of *Ophiocoma nigra*! Sir John Dalyell ('Powers of the Creator Displayed,' &c., vol. i. 1851, p. 118, pl. 29) has also described and figured *Ophiocoma nigra* under the name of *Ophiura punctata*. It is highly probable that he procured his erroneous specific name from an examination of the misleading specimen in the British Museum. It need scarcely be added that Forbes's obscure species bears not the slightest resemblance to *O. nigra*, with which it has thus been confused.

The name *O. punctata* has precedence in point of date over *A. Chiaiïi*; but as there is some degree of doubt respecting the identity of the former with the latter, as both were described by the same author, and as *A. Chiaiïi* has been generally adopted, it seems desirable that that name should be permanently retained for the species.

Shetland; Durham and Northumberland coasts; Clyde (Norman); Inverary and Oban (Mr. D. Robertson); "Hebrides" (Forbes).

A. Chiaiïi may at once be distinguished from *A. filiformis* by the absence of anchor-headed spines, and by the presence of the

larger scales at the centre of the disk, as well as by the other characters given above. From *A. brachiata* it may be known by the six radiating disk-scales and the less numerous arm-spines.

Amphiura brachiata (Montagu).

1841. *Ophiocoma brachiata*, Forbes, Brit. Starfishes, p. 45.
 1842. *Ophiolepis brachiata*, Müll. & Troschel, Syst. der Asteriden, p. 96.
 1857. *Amphiura Neapolitana*, Sars, Bid. Middlehavets Litt. Fauna, p. 91, pl. 1. figs. 11-15.
 1859. *Amphiura brachiata* and *A. Neapolitana*, Lütken, Addit. ad hist. Ophiuridarum, Anden Afdeling, p. 114.

Disk covered with small imbricated scales, which assume a spinose form at the margins, where they stand out from the surface; radiating scales triangular, diverging, widest at their centre, and having a furrow across the base; under surface of disk closely covered with minute scales. Arms extremely long and very slender; spines 8-12, short, thick, and of nearly equal length, all simple. Two papillary spines at each tentacular pore; the outer, however, is only present at the base of the arms. Upper arm-plates transversely oblong; lower quadrate, with two longitudinal furrows.

Sars's description of *Amphiura Neapolitana* agrees in every respect with our British species, except that in the specimens which I have examined the radiating plates have no granulations on their surface; but this can scarcely be regarded by itself as constituting a specific character. *Amphiura brachiata* has thus a range from the Mediterranean to the Firth of Clyde, whence I have had the opportunity of examining a specimen taken by Mr. D. Robertson on the shores of Little Cumbrae. The other recorded British habitats are Salcombe Bay (Montagu), and the coasts of Down and Antrim (Thompson).

Amphiura elegans (Leach).

1815. *Ophiura elegans*, Leach, Zool. Miscell. vol. ii. p. 57.
 1823. *Asterias squamata*, Delle Chiaje, Mem. sulla storia e anatomia degli animali del regno di Napoli, pl. 34. fig. 1.
 1835. *Ophiura neglecta*, Johnston, Mag. Nat. Hist. vol. viii. p. 467.
 1841. *Ophiocoma neglecta*, Forbes, Brit. Starfishes, p. 30.
 1842. *Ophiolepis squamata*, Müller & Troschel, Syst. der Asteriden, p. 94.
 1845. *Amphiura neglecta*, Forbes, Trans. Linn. Soc. vol. xix. p. 150.
 1861. *Amphiura squamata*, Sars, Oversigt af Norges Echinodermter, p. 21.

Amphiura elegans ranges from the Mediterranean and Ægean seas to Scandinavia. It is found all round our own coasts, under stones between tide-marks, and is also taken, though rarely, with the dredge.

Amphiura Ballii (Thompson).

1840. *Ophiocoma Ballii*, Thompson, Ann. Nat. Hist. vol. v. p. 99.

1841. *Ophiocoma Goodsiri*, Forbes, Brit. Starfishes, p. 57.
 1842. *Ophiolepis Ballii* and *Goodsiri*, Müller & Troschel, Syst. der Asteriden, p. 97.
 1848. *Ophiopholis Ballii* and *Goodsiri*, Gray, Brit. Mus. Cat. Brit. Radiata, p. 25.
 1857. *Amphiura Ballii*, Sars, Middlehavets Littoral Fauna, p. 99.
 1859. *Ophiactis Ballii*, Lütken, Addit. ad hist. Ophiuridarum, Anden Afdeling, p. 126.
 1861. *Amphiura Ballii*, Sars, Oversigt af Norges Echinodermer, pp. 17 & 20.

Disk lobed, covered with small imbricated scales, frequently produced at their apices into short spines, which are more numerous and longer towards the margin and on the under side of the disk; radiating scales triangular, diverging, their length equal to one-third the breadth of the disk. Arms of moderate length, their upper plates obtusely triangular, with the basal angle rounded; lower plates somewhat heart-shaped, with the basal angle rounded; spines 4-5, red, the two upper about equal to the breadth of the arm in length. Colour of disk yellowish or red, often mottled with these two colours; arms banded with red.

I have at length been able to determine positively what I had long suspected, that the two Starfishes described by Forbes under the names *O. Ballii* and *O. Goodsiri* are one and the same species. Through the kindness of Dr. E. Percival Wright, I have had the opportunity of examining the fragments which are preserved in the Dublin Museum of the types of Thompson's *O. Ballii*; while *O. Goodsiri* I have been enabled to satisfactorily identify through specimens which were named by Prof. Forbes, and which are preserved in the collection of Mr. Alder. I am unable to discover any structural difference between the two so-called species.

Amphiura Ballii inhabits the Scandinavian and British Seas. In the latter it has been taken at Shetland and off the coasts of Durham and Northumberland (Norman); Moray Firth (Mr. T. Edward); Dublin (Dr. Ball). It lives on hard ground, in deep water, and has a peculiar habit, delighting to nestle in hollows and crevices of stones, squeezing its disk and twisting its arms so as to conform to all the irregularities of the surface to which it attaches itself.

Genus VI. OPHIOPELTIS, Düben & Koren, 1846.

Disk membranous, and altogether naked, wholly devoid of scales and spines, except that there are two elongated plates over the origin of each arm. Arms simple, scaly, without any soft integument; lateral scales bearing spreading spines,

one of which is anchor-headed. Oral plates with papilliferous margins. No papillary spines at the tentacular pores.

Ophiopeltis securigera, Düben & Koren.

1846. *Ophiopeltis securigera*, Von Düben & Koren, Översigt af Scandinaviens Echinodermter, p. 236, pl. 6. figs. 3-6.

1861. *Ophiopeltis securigera*, Sars, Oversigt af Norges Echinodermter, p. 14.

Disk having the radiating scales long, narrow, and parallel.

Arms extremely long and very slender; upper scales triangular, lower cordate; lateral scales bearing three spines, of which the upper and lower are simple; but the middle is much swollen in the centre, and apically produced into an anchor- or, rather, axe-formed semicircular head, having a jagged edge. Disk greyish; arms bright orange.

A single specimen of this most interesting addition to our fauna was dredged in 1861, by Mr. Jeffreys and myself, on the haddock-ground about six miles to the north of the Whalsey Lighthouse, Shetland, in 40-50 fathoms. The species had, previously to the date just mentioned, been inserted as British in the "List of British Marine Invertebrate Fauna" published by the British Association; but, as far as we can learn, at that time it had not been taken in our seas; and it would seem that the name was inserted by mistake for *A. Chiajii*.

The arms of these species are more flexible than those of any other Echinoderm with which we are acquainted. They are commonly coiled upon themselves in many complete circles.

Genus VII. OPHIOCOMA, Agassiz, 1834.

Disk uniformly granular; no radiating plates over the base of the arms. Arms simple, covered with imbricated scales; spines of lateral plates spreading, very long, and serrated at the tips. Oral plates with papilliferous margins, the papillæ long and erect. One or two valvular scales at each tentacular pore.

Ophiocoma nigra (O. F. Müller).

1789. *Asterias nigra*, Müller, Zool. Dan. vol. iii. p. 20, pl. 93. figs. 1-4.

1828. *Ophiura granulata*, Fleming, British Animals, p. 488.

British and Scandinavian. Found all round our coasts, though somewhat local.

Genus VIII. OPHIOPHOLIS, Müller & Troschel, 1840.

Disk ornamented with rosulated scales, between which the surface is covered with very numerous close-set tubercles; no radiating plates over the base of the arms. Arms covered with

transversely oblong scales, which are separated from each other by transverse rows of tubercles; lateral plates bearing rather short, spreading, blunt, simple spines. Oral plates margined with a few flattened papillæ. One or two valvular plates over the tentacular pores.

Ophiopholis aculeata (O. F. Müller).

1776. *Asterias aculeata*, Müller, Zool. Dan. Prod. p. 235. no. 2841; and
1789. Zool. Dan. vol. iii. p. 29, pl. 99. figs. 1-3.
1828. *Ophiura bellis*, Fleming, British Animals, p. 488.
1842. *Ophiolepis scolopendrica*, Müller & Troschel, Syst. der Asteriden,
p. 96.
1858. *Ophiopholis aculeata*, Lütken, Addit. ad hist. Ophiuridarum, Förste
Afdeling, p. 60, pl. 2. figs. 16, 17.

Found all round our coast, but scarcer in the south. To the north it ranges throughout the Scandinavian seas, and occurs also in Greenland and Western America.

Genus IX. OPHIURA, Lamarck.

Ophiura, Lamarck, 1814; *Ophiolepis* (partly), Müller & Troschel, 1840.

Disk covered with smooth scales, of which two, larger than the rest and triangular, are situated over the inserted base of each arm. Arms simple, scaly; spines three, appressed and articulated to the distal margin of the overlapping side-plates. Interradial plates large, shield- or fiddle-shaped, produced into the interbrachial spaces. Clasping-scales at the junction of the arms with the disk furnished with spines or papillæ on their edge. Oral plates with papilliferous margins.

Ophiura lacertosa (Pennant).

1733. *Stella lacertosa*, Linck, De Stellis marinis, p. 47, pl. 2. fig. 4.
1777. *Asterias lacertosa*, Pennant, Brit. Zool. vol. iv. p. 63.
1805. *Asterias ciliata*, Retzius, Diss. sistens species cognitæ Asteriarum,
p. 29.
1816. *Ophiura texturata*, Lamarck, Hist. Anim. sans Vert. vol. ii. p. 542.
1842. *Ophiolepis ciliata*, Müll. & Troschel, Syst. der Asteriden, p. 91.

Interradial plates fiddle-shaped, much longer than broad, exceeding in length the space between their apices and the margin of the disk. Lateral ray-plates of the first few joints not meeting each other on the under surface of the arms, thus leaving a hollow pore in the centre between each inferior arm-plate. Dorsal arm-plates transversely oblong; ventral arm-plates lenticular. Spines not equalling in length the plates to which they are attached. Clasping-scales with 20-30 long and slender marginal spines. Three or four papilli-form spines at each tentacular pore.

Diameter of disk 1 inch.

All round our coasts, and ranging from the Mediterranean to

Scandinavia. It has also been recorded from Western America ; but possibly an allied species may have been there mistaken for it.

Ophiura Sarsii, Lütken.

1854. *Ophiura Sarsii*, Lütken, Videnskabelige Meddelelser fra der Naturhistoriske Forening i Kjöbenhavn, p. 95.
 1858. *Ophiura Sarsii*, Lütken, Addit. ad hist. Ophiuridarum, Förste Afdeling, p. 42, pl. 1. figs. 3, 4.
 1862. *Ophiura Sarsii*, Dujardin & Hupé, Hist. Nat. des Zoophytes Echinodermes, p. 250.

Nearly allied to, and as large as, *O. lacertosa*. Interradial plates shield-shaped, with straight sides, their length but slightly exceeding the breadth, and not equalling the space between their apices and the margin of the disk. Lateral arm-plates coalescing on the under surface of the arms, thus leaving no pore. Dorsal arm-plates transversely oblong ; ventral arm-plates lenticular (broader than in the last species). Spines exceeding the length of the lateral arm-plates. Two papilliform spines at each tentacular pore. Claspings-scales with about fifteen short flattened spines.

Diameter of disk nearly 1 inch.

Dredged by Messrs. Jeffreys, Waller, and myself at Shetland in 1861, and again in 1863, in 80–100 fathoms. It is an Arctic species, occurring throughout the Scandinavian seas and in Greenland.

Ophiura albida, Forbes.

Ophiura albida, Forbes, British Starfishes, p. 27.

Interradial plates shield-shaped, with straight sides, a little longer than broad, not equalling the distance between their apices and the margin of the disk. No pores. Dorsal arm-plates fan-shaped ; ventral arm-plates small, somewhat hexagonal, widely separated from each other by the juncture between them of the broad side-plates. Spines shorter than the lateral plates to which they are articulated. One papilliform spine at each tentacular pore. Claspings-scales with 10–15 short spines. Colour rosy, with the radiating plates over the base of the arms white.

Diameter of disk $\frac{5}{12}$ ths of an inch.

Dredged on every part of our coast, and found both in the Mediterranean and in Scandinavia.

Ophiura affinis, Lütken.

1858. *Ophiura affinis*, Lütken, Addit. ad hist. Ophiuridarum, Förste Afdeling, p. 45, pl. 2. fig. 10.
 1862. *Ophiura affinis*, Dujardin & Hupé, Hist. Nat. des Zoophytes Echinodermes, p. 250.

1863. *Ophiura Normani*, Hodge, Transactions Tyneside Naturalists' Field-Club, vol. v. p. 296, pl. 16. figs. 1-3.

Disk rosulated, having a central scale surrounded by five, then five outside these again, the interspaces of these larger scales filled up with small round scales. Interradial plates fiddle-shaped, longer than broad, not equalling in length the space between their apices and the margin of the disk. Arms long, slender, and very flexible. No pores as in *O. lacertosa*. Dorsal arm-scales transversely oblong; ventral lenticular, small, separated from each other by the junction of the lateral arm-plates. Spines as long as, or longer than, the lateral plates. One papilliform spine over each tentacular pore. Clasping-scales with about ten spines, and a circlet of spines meeting over the insertion of the arm.

Diameter of disk $\frac{3}{12}$ ths of an inch.

It is probable that this pretty little species will prove to be not unfrequent in our seas. We have dredged it in 20-40 fathoms in the Firth of Clyde, at Shetland, and off the Northumberland coast; and Mr. Hodge has procured it at Seaham, in the county of Durham. Mr. Hodge has described this species as British, under the name of *Ophiura Normani*, which must, however, yield to the prior appellation of Lütken, which we have here adopted. The type specimens were from the coast of Norway.

Ophiura squamosa, Lütken.

1854. *Ophiura squamosa*, Lütken, Videnskabelige Meddelelser fra der Naturhistoriske Forening i Kjöbenhavn, p. 95.
 1857. *Ophiura squamosa*, Lütken, Oversigt over Grönlands Echinodermata, p. 50.
 1858. *Ophiura squamosa*, Lütken, Addit. ad hist. Ophiuridarum, Förste Afdeling, p. 46, pl. 1. fig. 7.
 1862. *Ophiura squamosa*, Dujardin & Hupé, Hist. Nat. des Zoophytes Echinodermes, p. 251.

Disk entirely covered with small imbricated scales of equal or nearly equal size. Interradial plates triangular, as broad as long, shorter than the distance from their apices to the margin of the disk. No pores. Dorsal arm-plates fan-shaped; ventral small, cordate, and emarginate at the apex. The longest of the spines equals the length of the lateral plates. One papillary spine to each tentacular pore. Clasping-scales with very few and short marginal spines.

Diameter of disk $\frac{2}{12}$ ths of an inch.

This small *Ophiura* has been found abroad in Norway, Fimmark, and Greenland. All the British specimens that we have hitherto seen have been taken on the east coast. Mr. Alder and the author have procured it off Cullercoats; Mr. Hodge at Sea-

ham; and Mr. Edward has sent it to us from Banff. It is an inhabitant of the coralline zone.

Order III. ASTEROIDEA.

Body stellate or angular, produced into five or more, more or less elongated lobes or hollow arms, or rather rays, which are perfectly continuous with the disk, and contain caecal prolongations of the viscera. These rays throughout the entire length of the oral surface are centrally hollowed into channels, called ambulacra, from which are protruded two or four rows of suckers. Reptation by means of these suckers and of others which are situated on the disk. Skeleton composed of numerous calcareous plates, variable in number and size, and supporting a coriaceous envelope which is pierced on the aboral surface by pores for the protrusion of respiratory tentacles, and bearing for the most part numerous spines. These spines are often collected together in groups, supported on pedestal-like columns, which columns with their accompanying spines are called paxillæ. Mouth inferior, central, sometimes also serving as the vent; a special anal opening is, however, more generally present, on the centre of the aboral surface. Respiration complicated, being partly effected by means of the aboral respiratory tentacles, partly by the ambulacral tentacles, and partly by the entire ciliated epithelium of the surface of the body. A madreporiform tubercle—a filter for the admission of water—on the aboral surface of the disk more or less eccentrically placed. Eyes situated at the extremity of the arms. With or without one or two kinds of pincer-like pedicellariæ, formed of two opposing calcareous pieces. Sexes distinct. Ovaries ten; their special openings, when present (which is not always the case), on the aboral surface, between the origins of the arms.

Fam. I. Astropectinidæ.

No special anal opening. Two rows of ambulacral tentacula.

Genus X. ASTROPECTEN, Linck.

[*Astropecten*, Linck, 1733, and Gray, 1841; *Stellaria*, Nardo, 1831 (nom. usit.); *Asterias* (restricted), Agassiz, 1837.]

Disk, together with the five long rays, flat above, and covered in every part by closely aggregated paxillæ. Two rows of lateral plates, the upper covered with granules, the lower clothed with spines, which are shorter on the inferior portion, and gradually increase in length towards the upper margin, where they are long. Suckers biserial. No anus. Madreporiform tubercle near the margin of the disk. No pedicellariæ. Respiratory pores very numerous.

Astropecten irregularis (Pennant).

1776. *Asterias aurantiaca*, Müller, Zool. Dan. Prod. p. 234, no. 2831 (*but not of Linnæus*).
 1777. *Asterias irregularis*, Pennant, Brit. Zool. vol. iv. p. 61. no. 47.
 1841. *Asterias aurantiaca*, Forbes, Brit. Starfishes, p. 130.
 1844. *Astropecten Mülleri*, Müller & Troschel, Archiv für Naturgeschichte, vol. x. p. 181.
 1844. *Astropecten echinulatus*, Müller & Troschel, Archiv für Naturgeschichte, vol. x. p. 181 (*fide* Sars).

Marginal plates 20–40. Greater to lesser radius as 4–6 to 1. Spines of the under surface flattened, spatulate, widening at the tips. Each inferior marginal plate bears one transverse row of spines, which exceed the rest in length, and themselves gradually increase in size towards the superior margin of the plates.

Common all round the coasts of Great Britain, and found in Scandinavia. My largest specimen measures 6 inches in diameter.

Astropecten acicularis, n. sp.

Marginal plates 20–23. Greater to lesser radius as 3–4 to 1. Spines of the under surface aciculate (not spatulate or widening at the tips), and only the large spines of the inferior marginal plates slightly flattened. Inferior marginal plates with two transverse rows of larger spines, which gradually increase in length towards the superior margin of the plates. 2 inches in diameter, from tip to tip of the rays.

This species resembles the last closely in every particular with respect to the aboral surface, but differs greatly in the character of the spiny armature of the inferior portion of the body. The rays are rather shorter than is usual in *A. irregularis*. The three innermost spines of the adambulacral plates (of which the central is the longest, and curved, and all are cylindrical) are projected over the ambulacra. All the spines of the under surface are slender and pointed, and thus differ widely from the flattened, widening spines of *A. irregularis*. The inferior marginal plates, instead of being covered, as in *A. irregularis*, with a cushion of closely appressed, short, broadly flattened spines, and a single transverse row of much larger and conspicuous spines (generally, though not always, greatly flattened), are furnished with cylindrical slender spines of various lengths, from among which the chief row does not stand out so conspicuously.

Astropecten acicularis was dredged by me in 1861, in company with Messrs. Jeffreys and Waller, on the Outer Haaf at Shetland, living gregariously in 80–100 fathoms. It does not appear to agree with any of the numerous species of this genus which have hitherto been described.

Genus XI. *LUIDIA*, Forbes.[*Luidia*, Forbes, 1839; *Hemicnemis*, Müller & Troschel, 1840.]

Rays 5-7, very long, narrow at the base, and of nearly equal diameter throughout, together with the disk flat above, and covered in every part by closely aggregated paxillæ. A single row of lateral ray-plates, which, together with the whole under surface, are covered with slender, acute spines. Suckers biserial. No anus. Madreporiform tubercle near the margin of the disk. A single row of pedicellariæ alternating with pores in a groove on the exterior side of the adambulacral plates. Respiratory pores very numerous.

It has always hitherto been stated that this genus was unprovided with pedicellariæ. Such a statement, however, is incorrect. These remarkable organs are present, and hold, moreover, an isolated and peculiar position, which, I believe, is without a parallel among other Echinodermata. If the oral surface of a *Luidia* be carefully examined, there will be found on either side of the ambulacra, and midway between the ambulacra and the margin of the rays, or, in other words, exterior to the adambulacral plates, a longitudinal row of pores situated in a sulcus; and, crowning each of the calcareous rib-like plates which separate these pores from each other, there will be observed a single, erect, triangular, pincer-formed pedicellaria. It is not a little remarkable that these organs, which are by no means inconspicuous, should have apparently wholly escaped the observations of Von Düben and Koren (who give a carefully executed figure of a section of the under surface of a ray of *Luidia Sarsii*) and of Sars, who, in his 'Middlehavets Littoral Fauna,' draws the specific character in our two species from the number and form of the spines of the adambulacral plates, which, as we have seen, are immediately adjacent to the avenues in which the pedicellariæ are situated. The pedicellariæ themselves are organs which we find to afford valuable specific distinction in this genus. In *Luidia Savignii* they are short, broad, and tumid—in fact, in the form of a nearly equilateral and equiangular triangle; while in *Luidia Sarsii* they are much more elongated, narrow, and not tumid, and have the outline of a somewhat produced isosceles triangle. The peculiar position which the pedicellariæ occupy in this genus will, we doubt not, form almost necessarily a ground of argument with those naturalists who shall hereafter discuss the nature of the functions which these anomalous and peculiar appendages of the Echinodermata discharge.

Luidia Savignii (Audouin).

1828. *Asterias Savignii*, Audouin; Savigny, Histoire de l'Égypte, pl. iii. (1809); description (1828), vol. xxiii. p. 9.

1839. *Luidia fragilissima*, Forbes, Mem. Wern. Soc. vol. viii. p. 123 (partly), but not woodcut.
 1841. *Luidia fragilissima*, Forbes, Brit. Starfishes, p. 135 and woodcut.
 1842. *Luidia Savignii*, Müller & Troschel, Syst. der Asteriden, p. 77.
 1857. *Luidia Savignii*, Sars, Middlehavets Littoral Fauna, p. 100.

Seven-rayed, 1–2 feet in diameter. Spines bordering on the ambulacra in two rows, the inner slightly arched, the outer nearly twice as stout and long as the inner. Exterior to these a row of broadly triangular tumid pedicellariæ and respiratory pores alternating with each other.

Luidia Savignii is found in the Mediterranean and thence to the seas of Scandinavia. On our own coasts it seems widely distributed, occurring here and there all round Great Britain. We have either taken or seen it from Polperro (Mr. Laughrin); Clyde, Hebrides, and Shetland (A. M. N.); and Redcar, in Yorkshire (Mr. Ferguson). Other habitats will be found recorded in Professor Forbes's work.

Most deservedly is this species named after M. Savigny. His figure in the 'Histoire de l'Egypte' is a marvellous example of the perfection to which the engraving of objects of natural history can be carried. It is a masterpiece. Drawn life-size on a folio plate, the minutest details—each paxilla and each spine—have been elaborated with wonderful skill; yet nothing is overdrawn or exaggerated. Nature has been, as it were, photographed—and that, too, before photography was discovered—by the artist on his plate.

Luidia Sarsii, Düben & Koren.

1839. *Luidia fragilissima*, Forbes, Mem. Wern. Soc. vol. viii. p. 123 (partly) and woodcut.
 1841. *Luidia fragilissima*, Forbes, Brit. Starfishes, p. 135 (partly), but not woodcut.
 1844. *Luidia Sarsii*, Düben & Koren, Oversigt af Kong. Vet. Akad. Förh. p. 113.
 1844. *Luidia Savignii*, Düben & Koren, Skand. Echin. p. 254, pl. viii. figs. 23, 24.
 1857. *Luidia Sarsii*, Sars, Middlehavets Littoral Fauna, p. 102.

Five-rayed, rarely exceeding 6 inches in diameter. Spines bordering on the ambulacra in three rows, the inner much curved and flattened at the tip; the middle a little longer, thicker, and straighter; the outer straight, equalling the inner row in length. Exterior to these a row of narrowly triangular pedicellariæ and respiratory pores alternating with each other.

Apparently of more northern range than the last. It has been met with in Norway; and has been taken by myself in Shetland, and traced thence along the eastern coast of Great Britain as far south as Yorkshire. There is no record of a western or southern

locality, though there can be little doubt that it will be found hereafter among the Hebrides.

Fam. II. Solastridæ.

A special anal opening, situated in the centre of the aboral disk. Two rows of ambulacral tentacula.

Genus XII. ARCHASTER, Müller & Troschel, 1840.

Disk; together with the five moderately long rays, flat above, and covered in every part by closely aggregated paxillæ. Two rows of large lateral plates, the upper covered with large granules or mamillary spines; the lower covered with closely appressed, short, papillose spines. Suckers biserial. Anus central. Pincer-formed pedicellariæ present. Respiratory pores isolated among the paxillæ.

Archaster Parelii (Düben & Koren).

1768. *Asterias aurantiaca*, var., Parelius, Kongelige Norske Videnskabers Selskabs Skrifter, Act. Nidross. iv. p. 325, pl. xiv. figs. 3, 4.

1844. *Astropecten Parelii*, Düben & Koren, Skand. Echin. p. 247, pl. vii. figs. 14-16.

1861. *Archaster Parelii*, Sars, Oversigt af Norges Echinodermter, p. 35.

Greater to lesser radius as 3 to 1. Aboral surface entirely covered with closely aggregated paxillæ. Each of these paxillæ consists of a pillar, widening above and supporting about twenty-five (15-30) mamillary spines of different sizes. Madreporiform tubercle nearer to the centre than to the margin of the disk, minute, not so large as one of the paxillæ. Lateral ray-plates thirty, oblong, entirely covered with mamillary spines of the same kind but larger than those of the paxillæ, nearly a hundred on each plate. Oral surface entirely covered with closely packed short papillose spines. The inferior lateral plates are most beautiful cushions of closely aggregated, appressed papillary spines, each plate having a central row of 3-5 rather larger and more conspicuous spines, which, however, like all the rest, are closely appressed to the surface. Indeed there are no spines projecting conspicuously beyond the rest from any part of the body. The spines of the ambulacral plates are so numerous that, spreading from them in all directions, they nearly choke up the ambulacral channels. Greater diameter not quite 4 inches.

A single specimen of *Archaster Parelii* was dredged by Messrs. Jeffreys and Waller, during the past summer, on the Outer Haaf, off Shetland, in 100 fathoms. It is a very interesting addition to our list of British Echinodermata. I have removed this species from the genus *Astropecten*, in which it had been

placed by Düben and Koren, and placed it in *Archaster* on the authority of Professor Sars. I am unable myself to vouch for the correctness of this transfer, as I have been unwilling to injure the only British specimen in order to ascertain the presence of those organs (the anal aperture and pedicellariæ) which separate the genus *Archaster* from *Astropecten*.

Genus XIII. PALMIPES, Linck.

[*Palmipes*, Linck. 1733, and Agassiz, 1837; *Asteriscus*, Müll. & Trosch. (partly), 1840.]

Body pentagonal, extremely thin and flat; sides greatly produced beyond the central cavity in the form of a thin lamella. Surface furnished with fascicles of spines (not paxillæ). These fascicles are arranged, especially on the under surface, in radiating lines. Each adambulacral plate bears about five spines, the central of which is the longest. The body and rays have an acute edge unprovided with marginal plates or spines. Suckers biserial. Anus subcentral. No pedicellariæ. Madreporiform tubercle towards the margin of the central cavity, but at some distance from the edge of the disk.

This genus appears to differ totally in structure from all other Starfishes. Its greatly flattened disk and rays are built up of an immense number of battledore-shaped calcareous plates, which are most interesting objects for the microscope, on account of the elegance of their form and the beauty of their structure. They are everywhere perforated, except where strengthened by delicate rib-like processes which pass from the shaft to the distal extremity of the plate. These plates are laid one over another, both on the oral and aboral surface, like the roofing of a house thatched with palm-leaves; and the shafts of the plates are buried between the plates of the opposite surface of the disk. Thus the whole structure is built up; and it is the peculiarly fragile character of these calcareous plates which makes this Starfish so very brittle when preserved. The fascicles of spines of the surface of *Palmipes* are attached to the calcareous plates, each plate bearing a transverse row of spines across its rounded distal extremity. I am not aware that the unique character of the skeleton of this Starfish has previously been noticed.

Palmipes placenta (Pennant).

1777. *Asterias placenta*, Pennant, Brit. Zool. vol. iv. p. 62, no. 50, pl. xxxi. fig. 59 A.

1783. *Asterias membranacea*, Retzius, Kong. Vet. Akad. Nya Handl. vol. iv. p. 238.

1839. *Palmipes membranaceus*, Forbes, Mem. Wern. Soc. vol. viii. p. 119, pl. iii. fig. 3.

Palmipes placenta is a southern species, found in the Mediter-

ranean and on the southern and western shores of our island, attaining its northern limit at Shetland, where we dredged it in 1861 and again in 1863, and descending the eastern coast as far as the Moray Firth. It appears to be wholly absent from the rest of the eastern side of Great Britain.

Genus XIV. ASTERINA, Nardo.

[*Asterina*, Nardo, 1834. *Asteriscus*, Müll. & Trosch. (partly), 1840.].

Body convex above, or even gibbous, flat beneath; rays very short; whole form somewhat pentagonal. Margin of disk and arms sharp-edged, bordered with short spines, but having no distinct marginal plates. Surface above and below bearing numerous fascicles of short spines; 2–4 spines in each fascicle. Respiratory pores very numerous and conspicuous. Suckers biserial. Anus subcentral. Madreporiform tubercle midway between the centre and the margin of the disk.

Müller and Troschel formed a genus *Asteriscus* for the reception of *Palmipes placenta* and *Asterina gibbosa*, and thus not only unwarrantably used a genus of their own in preference to adopting and enlarging, if necessary, the generic character of one of those previously described, but united two forms which differ in the character of their whole structure from each other.

Asterina gibbosa (Pennant).

1777. *Asterias gibbosa*, Pennant, Brit. Zool. vol. iv. p. 62, no. 49.

1805. *Asterias verruculenta*, Retzius, Dissert. sistens species cog. Asteriarum, p. 12.

1841. *Asterina gibbosa*, Forbes, British Starfishes, p. 119.

1842. *Asteriscus verruculentus*, Müller & Troschel, Syst. der Asteriden, p. 41.

Dujardin and Hupé, in their ‘Histoire Naturelle des Zoophytes Échinodermes,’ published in 1862, say of this species, “Les pédicellaires sont nombreuses, sétacées, placées entre les plaques”; but, although we have examined it most carefully, we are unable to detect any such organs as are described in these words. But, although true pedicellariæ appear to be wholly absent in *Asterina gibbosa*, there are certain spines in this species which may, perhaps, in some degree discharge the functions of these appendages. The spines of the surface are usually arranged in groups of three or four together; but between these groups there will be noticed not unfrequently pairs of spines, of similar character in their general structure to the other spines of the surface, but placed close together at the base, and of slightly arched form, so that the apices can be brought into contact with each other. We seem to have here a transition state between ordinary spines and true pedicellariæ: the form and structure is more that of

the former, but the function may in some degree be that of the latter; and these arching spines are perhaps employed as imperfect instruments of prehension.

This species is, for the most part, a southern form; but it is met with here and there on the western shores of Great Britain, and attains its northern limit on the coast of Rosshire, where it was found by Professor Edward Forbes. It appears to be entirely absent on the east coast.

Genus XV. SOLASTER, Forbes.

[*Solaster*, Forbes, 1839. *Crossaster*, Müller & Troschel, 1840.]

Body convex, covered above and below with paxillæ. Rays 8-14, long, rounded above. No marginal plates or rows of spines edging the disk and arms. Respiratory pores very numerous, everywhere situated between the paxillæ. Suckers biserial. No pedicellariæ. Anus central. Madreporiform tubercle midway between the centre and the margin of the disk.

Solaster papposus (Linnæus).

Solaster papposa, Forbes, British Starfishes, p. 112.

Everywhere round our coasts. Not known to the south of Great Britain; but extending northwards to Scandinavia, Finland, Iceland, Greenland, and western North America.

Solaster endeca (Linnæus).

Solaster endeca, Forbes, British Starfishes, p. 109.

With similar British and exotic range to the last; but not so abundant, and an inhabitant of deeper water, never occurring between tide-marks.

Genus XVI. PORANIA, Gray.

[*Goniaster*, Agassiz, 1857 (partly). *Porania*, Gray, 1841. *Asteropsis*, Müller & Troschel, 1842.]

Body pentagonal, very convex and tumid above, flat beneath. Rays very short. Oral surface composed of elegantly tessellated plates. Aboral surface composed of similar but less regular plates, and covered, when alive, with a thick and highly lubricated membrane. No spines, or paxillæ, or pedicellariæ, except that a circlet of small spines closes over the anal opening, which is central, and that the sharp edge of the disk and rays is fringed with a row of spines arranged in single file. Respiratory pores very numerous, in groups. Suckers biserial. Madreporiform tubercle midway between the centre and the margin of the disk.

Porania pulvillus (O. F. Müller).

1788. *Asterias pulvillus*, Müller, Zool. Dan. vol. i. p. 19, pl. xix. figs. 1, 2.

1839. *Goniaster Templetoni*, Forbes, Mem. Wern. Soc. vol. viii. p. 118, pl. iv. fig. 2.
 1841. *Porania gibbosa*, Gray, Ann. Nat. Hist, vol. vi. p. 288.
 1842. *Asteropsis pulvillus*, Müller & Troschel, Syst. der Aster. p. 14.

Porania pulvillus, though not common, occurs on the southern, western, and northern coasts of Great Britain; but is wholly absent on the east, where its place is taken by the next species. It is an inhabitant of the Norwegian and Swedish seas.

Genus XVII. GONIASTER, Agassiz.

[*Goniaster*, Agassiz, 1837. *Hippasteria*, Gray, 1841. *Astrogonium*, Müller & Troschel, 1842.]

Body pentagonal, flat beneath, convex above; rays of moderate length. Oral and aboral surfaces covered with elegantly tessellated plates, each of which is surrounded by a row of granules, and bears on its centre either a large tubercle or a semi-elliptic pedicellaria. Two rows of square marginal plates, each surrounded by a beaded margin of granules, and bearing one, two, or three strong tubercular spines. Respiratory pores in the narrow interspaces of the plates. Suckers biserial. Anus sub-central. Madreporiform tubercle nearer to the centre than to the margin of the disk.

Goniaster phrygianus (Parelius).

1768. *Asterias phrygiana*, Parelius, Kong. Norske Videnskabers Selskabs Skrifter (Act. Nidros.), vol. iv. p. 424, pl. xiv. figs. 1, 2.
 1788. *Asterias equestris*, Gmelin?, Lin. Syst. Nat. no. 3164.
 1841. *Goniaster equestris*, Forbes, British Starfishes, p. 125.
 1841. *Hippasteria plana*, *Europæa*, and *Johnstoni*, Gray, Ann. Nat. Hist. vol. vi. p. 279.
 1842. *Astrogonium phrygianum*, Müller & Troschel, Syst. der Asteriden, p. 52.
 1843. *Goniaster Abbensis*, Forbes, Ann. Nat. Hist. vol. xi. p. 280, pl. vi.
 1857. *Astrogonium aculeatum*, Barrett, Ann. Nat. Hist. ser. 2. vol. xx. p. 47, pl. iv. fig. 4 (variety).
 1861. *Astrogonium phrygianum*, var., Sars, Oversigt af Norges Echinoderm, p. 44 (variety).

This species is found in deep water off the Shetland and Orkney Islands and the north of Scotland, and ranges thence down the eastern side of Great Britain as far south as Yorkshire. It is a member of the fauna of Norway, Sweden, Finmark, and western North America.

The pedicellariæ of this species differ wholly in form from those of all other British Echinodermata. They consist of two semielliptic, slightly arched, strong, calcareous valves which close over an aperture in the plate to which they are attached. The muscles by which the pedicellariæ are worked pass through the aperture just mentioned. It is not uncommon to find grains of

sand or small animals—for example, Copepod Crustacea—held tight in the grasp of these pincer-formed organs.

A remarkable variety of this species was described, from the Norway coast, by Mr. Barrett, under the name of *Astrogonium aculeatum*. It differs from the type in having the tubercular spines of the aboral surface less strongly developed than usual, and those of the superior lateral plates wholly absent. In these respects it shows some approach towards *Goniaster granularis* (O. F. Müller). This form has for the first time been found in the British seas, during the past summer, by Messrs. Jeffreys and Waller, who procured it in very deep water off Shetland. Although at first sight it looks very different from the type, I have intermediate forms in my collection, and am satisfied that Professor Sars is right in having regarded it as a variety of the present species.

Genus XVIII. CRIBRELLA, Agassiz.

[*Linckia*, Nardo, 1834 (nom. usit.). *Cribrella*, Agassiz, 1837. *Henricia*, Gray, 1841. *Echinaster*, Müller & Troschel, 1842 (partly).]

Body convex, with five very long, slender, and well-rounded rays; covered in every part with tufts of short spines. No marginal plates. Numerous isolated pores for the protrusion of respiratory tentacles in the intervals of the tufts of spines. Suckers biserial. Anus subcentral. No pedicellariæ. Madreporiform tubercle, covered with spines, situated midway between the centre and margin of the disk.

Forbes spelt the name of this genus *Cribella*; but Agassiz's rendering of it is *Cribrella*—from *cribrum*, not from *cribellum*.

Cribrella sanguinolenta (O. F. Müller).

- 1776. *Asterias sanguinolenta*, Müller, Zool. Dan. Prod. p. 234. no. 2836.
- 1777. *Asterias oculata*, Pennant, Brit. Zool. vol. iv. p. 61, no. 46. pl. xxx. figs. 5, 6.
- 1841. *Cribella oculata*, Forbes, British Starfishes, p. 100.
- 1841. *Henricia oculata*, Gray, Ann. Nat. Hist. vol. vi. p. 184.
- 1842. *Echinaster oculatus*, Müller & Troschel, Syst. der Aster. p. 24.
- 1842. *Echinaster Eschrichtii*, Müller & Troschel, Syst. der Asteriden, p. 25 (fide Sars).
- 1844. *Echinaster Sarsii*, Müller & Troschel, Archiv für Naturgeschichte, vol. x. p. 179 (fide Sars).
- 1853. *Linckia oculata et pertusa*, Stimpson, Invertebrata of Grand Manan, p. 14.
- 1857. *Cribrella sanguinolenta*, Lütken, Oversigt over Grönlands Echinodermata, p. 31.

Cribrella sanguinolenta occurs all round the coasts of Great Britain and Ireland, and in all depths of water from between tide-marks down to 100 fathoms. It is a very variable species; and more than one of its forms we have at times been inclined almost

to regard as distinct species. The variety from the deepest water of the Shetland Islands is peculiarly marked. It rarely exceeds 2 inches in its greatest diameter, is of a brilliant saffron-yellow colour, and has the rays peculiarly rounded and firmer in structure than usual. The spines, also, are much shorter and more delicate than in ordinary specimens, and have their apices much more distinctly trifid.

The largest specimens which we have seen of this species are in Mr. Bean's collection, and were procured by him at Scarborough. A monstrosity in our collection has six, and another seven rays.

Cribrella sanguinolenta is an Arctic species of very extensive range. It has been met with in the seas of Norway, Sweden, the Faro Islands, Finmark, Iceland, Greenland, western North America, and Kamtschatka.

Fam. III. Asteriadae.

A special anal opening. Four rows of ambulacral tentacula.

Genus XIX. STICHAETER, Müller & Troschel.

[*Stichaster*, Müller & Troschel, 1840. *Asteracanthion*, Müller & Troschel, 1842 (partly).]

Body convex, with five greatly elongated, slender, compact, well-rounded rays, closely covered above by short tubercular spines, and pierced with very numerous tentacular pores arranged in longitudinal rows. No marginal plates or spines. Suckers quadriserial. Anus central. Pedicellariæ numerous, of one kind only. Madreporiform tubercle close to the margin of the disk, not covered with spines.

The presence of four, instead of two, rows of ambulacral tentacula give the *Asterias rosea* of Müller claims to be placed, not only in a different genus, but in a different family from the *Asterias sanguinolenta* of the same author, with which it was associated by Professor Forbes in the genus *Cribrella*. The species has closer affinities with *Asterias* restricted (*Asteracanthion*, M. & T.), in which genus it was arranged by Müller and Troschel in their 'System der Asteriden.' The peculiarly produced, well-rounded, compact arms of this species, with the close covering of tubercular spines, and the lateral position of the Madreporiform tubercle, justify its separation from the typical species of *Asterias*.

Stichaster roseus (O. F. Müller).

1776. *Asterias rosea*, Müller, Zool. Dan. Prod. p. 234. no. 2837.

1841. *Cribella rosea*, Forbes, British Starfishes, p. 106.

1842. *Asteracanthion roseus*, Müll. & Troschel, Syst. der Asteriden, p. 17.

1861. *Stichaster roseus*, Sars, Oversigt af Norges Echinodermes, p. 86.

A deep-water species, an inhabitant of the Scandinavian seas.

Though scarce, it appears to have been found, here and there, round our coast. We have ourselves taken it off Shetland and the Northumberland coast, and have received it from Mr. T. Edward, from the Moray Firth.

Genus XX. *ASTERIAS*, Linnæus.

[*Asterias*, Linnæus, 1748. *Stellonia*, Nardo, 1834 (partly). *Uraster*, Agassiz, 1837. *Asteracanthion*, Müller & Troschel, 1840.]

Body with five elongated, subcompressed or moderately convex and often angulated rays, furnished with spines placed singly, and either scattered over the surface or arranged in regular longitudinal lines. No marginal plates or spines. Suckers quadriserial. Anus central. Pedicellariæ of one or two kinds: the one small, with interlocking blades always present and grouped round the base of the spines; the second form much larger than the first, pincer-formed, and, when present, scattered over the surface. Madreporiform tubercle situated midway between the centre and the margin of the disk.

Müller and Troschel, in their 'System der Asteriden,' have wholly suppressed the Linnæan genus *Asterias*, and have been followed by most Continental authors who have of late years written upon the Echinodermata. Such a proceeding, however, is on all accounts most undesirable, and wholly at variance with the established laws of nomenclature. What species, then, is to be regarded as the type of the Linnæan genus? Opinion has been in some measure divided between the *Asterias rubens* and the *A. aurantiaca*. It is to the latter species and its allies that the genus was restricted by Agassiz, who was followed by Forbes, as well as by Müller and Troschel in their first memoir in the 'Bericht der Berliner Akademie' for 1840. But for this species Linck had established a genus, *Astropecten*, in 1733. His work 'De Stellis marinis' was an excellent monograph, when we consider the period at which it was published; and by general consent, and with great justice, his genus is now recognized. There are other reasons, also, which seem to point to *Asterias rubens* as the most proper type of the Linnæan genus; and we have therefore followed Dr. Gray in so regarding it. Moreover, if *Asterias* were rejected as the generic name for this species, Müller and Troschel's *Asteracanthion* could not be adopted, since both *Stellonia* of Nardo and *Uraster* of Agassiz have precedence of that genus.

Asterias glacialis, Linnæus.

Uraster glacialis, Forbes, British Starfishes, p. 78.

Rays distinctly angulated, having three distinct and very conspicuous longitudinal rows of large spines extending the

whole length of their upper surface, and terminating at a circlet of similar spines on the disk. Under surface of arms margined with a double row of spines, of which the outer are the longer; and having very numerous small spines arranged in single file overhanging the ambulacra. Ambulacra wide at the base, and thence gradually tapering to the extremity of the rays. Pedicellariæ of two kinds,—the one very small, composed of two interlocking blades, grouped in vast numbers round the base of the spines; the other very much larger, pincer-formed, with simple margins and a somewhat digitiform apex, scattered over the surface. Greater to lesser radius as 7–8 to 1. A large species, measuring commonly from 1 to 2 feet across, and sometimes attaining yet greater dimensions.

It is not a little remarkable that this species, which is found in the Mediterranean and ranges to Finmark and Scandinavia, and is of frequent occurrence on the northern, western, and southern coasts of our islands, appears to be wholly absent from the east coast of England and Scotland. It is recorded in the "Dredging Reports of the Durham and Northumberland Coast," by Messrs. Brady and Hodge (Tyneside Nat. Field-Club Trans. vol. v. p. 285, and vol. vi. p. 190),—but erroneously, as the specimens referred to belong to the next species, which at the time of the drawing up of those Reports was not known, except to myself, as an inhabitant of the British seas.

Asterias Mülleri (Sars).

1846. *Asteracanthion Mülleri*, Sars, Fauna Litt. Norvegiæ, i. p. 56, pl. 8. figs. 38, 39.

1861. *Asteracanthion Mülleri*, Sars, Oversigt af Norges Echinoderm, p. 88.

Rays very convex, but not angulated: spines not large, more numerous than in the last species, and more irregularly disposed, but forming five longitudinal rows (namely, one central and two lateral on each side), the spines of all of which are of equal size. Spines of disk irregularly placed, not forming a distinct circlet. Under surface of rays as in the last species; but the spines bordering on the ambulacra larger in proportion to size of specimen, and therefore less numerous than in *A. glacialis*. Pedicellariæ of one kind only, minute, with interlocking blades, grouped round the base of the spines, but less numerous than in the last species; and the second and larger form, which is present in the latter, is wholly absent in this species. Greater to lesser radius as 4–6 to 1. More nearly allied to *A. glacialis* than to *A. rubens*. The British examples that I have seen do not exceed 2 inches

in diameter; but Sars gives $4\frac{1}{2}$ inches as the measurement of a Norwegian specimen, but adds, "sæpissime minor."

This pretty little species, now first recorded as British, was first procured by me in 1861, when dredging at Shetland in company with my friend Mr. Jeffreys. It has since been obtained, as already mentioned, on the Durham coast. When alive, it is whitish, with more or less of a rosy pink colour on the upper surface.

Asterias rubens, Linnæus.

Uraster rubens, Forbes, British Starfishes, p. 83.

Rays moderately convex, gently rounded; spines small, not clavate, irregularly disposed over the surface of the disk and rays, except that there is a central line more or less distinct, and that the sides of the rays are bounded below by a fringe of spines, which are somewhat larger than those of the rest of the surface, and are placed in pairs or threes, two or sometimes three spines being situated on each plate. Under surface of rays having exteriorly groups of spines, generally three in number, placed diagonally on each plate, and interiorly on the adambulacral plates more slender spines, arranged in two or three rows bordering on the ambulacra. Ambulacra wide at the base, and gradually narrower towards the extremity of the rays. Pedicellariæ of two kinds,—the smaller of the same character as those of *A. glacialis*; the larger pincer-formed kind consisting of two blades with serrated edges, very numerous, scattered over the surface. Greater to lesser radius about as 5 to 1. A large species, often a foot or even a foot and a half in diameter.

Everywhere round our shores.

Asterias violacea, O. F. Müller.

Uraster violacea, Forbes, British Starfishes, p. 91.

Closely allied to the last species, but does not attain such a large size. Spines somewhat clavate. Pedicellariæ, especially of the larger kind, far less numerous. Ambulacra distinctly contracted at the base, then widening, and afterwards tapering (more suddenly than in the last species) to the apex of the rays.

As widely distributed as the last, but apparently not found in such deep water.

Asterias hispida, Pennant.

Uraster hispida, Forbes, British Starfishes, p. 95.

Rays moderately convex, not angulated, very short. Spines small, somewhat clavate, not arranged in well-defined rows. Ambulacra partaking of the same form as the rays, short,

wide at the base, suddenly tapering at the apex. Pedicellariæ of one kind only, and very sparingly developed; the larger pincer-formed kind wholly absent. Greater to lesser radius as 2-3 to 1. A large specimen measures $1\frac{1}{2}$ inch in its greatest diameter.

We have found this species living gregariously between tide-marks at the Out-Skerries, Shetland; and Mr. D. Robertson has sent us specimens which he took under similar circumstances at Oban.

The species of *Asterias*, both British and foreign, allied to *A. rubens* are extremely difficult. We are unable to make up our minds whether we have only one very variable form or many species. We have described the two species distinguished by Forbes, *A. violacea* and *A. hispida*, but for the present feel compelled to reserve giving a positive opinion with respect to the value of their distinctive characters. Müller and Troschel, and also Sars, unite the former with *A. rubens*. We have other closely allied forms in our seas, which scarcely fall under the description of any species here described.

XIV.—Description of *Diphlogæna Hesperus*, a new Species of the Family Trochilidæ. By JOHN GOULD, F.R.S.

Male. Crown of the head brilliant, changeable, metallic blue and fiery red, the latter colour occupying the sides of the forehead, and the former running up the centre from the base of the bill to the crown, where it dilates into a broad patch; hinder part of the head and the nape changeable brown and bronze; back (as far as the rump, shoulders, abdomen, and flanks) green; throat and chest rich metallic golden green, with a small spot of violet in the centre of the former; primaries and secondaries rust-brown, with darker tips; upper and under tail-coverts and the forked tail deep cinnamon-red, the feathers of the latter tipped and edged near the extremities with bronzy green; thighs buff; bill straight, long, tubular, and black; feet brown. Total length $5\frac{1}{4}$ inches, bill $1\frac{1}{2}$, wing $3\frac{1}{4}$, tail $2\frac{1}{2}$.

Habitat. The province of Cuença, in Ecuador, where it procures its food from the flowers of the *Oreocallis grandiflora*, a tall shrub figured in Humboldt and Bonpland's folio work, vol. ii. p. 179, tab. 139.

This new species of Humming-bird is very nearly allied to *Diphlogæna Iris*, but differs in the more fiery colour of the face, the greater intensity of the blue occupying the centre of the crown, in the green of the body extending to the tail-coverts both on the upper and under surface, in the tail-feathers being all tipped with bronzy green, and in the tail itself being less deeply forked.

XV.—*On the Species of Manatees (Manatus), and on the Difficulty of distinguishing such Species by Osteological Characters.*
By Dr. J. E. GRAY, F.R.S.

THE species of Manatees (*Manatus*) appear to be in great confusion. The American and African animals have each had no less than five specific names. I believe this has chiefly arisen from skulls of different ages having been examined, and especially from the fewness of the specimens contained in museums compared with those now to be seen in London. The British Museum has specimens of the American and of the African kind, and there is a skeleton from each country and several skulls in the Museum of the College of Surgeons.

I will first give the history of the skulls which have been figured by preceding authors, on which the species have been founded, and then the result of the examination of the specimens in the British Museum and in the Museum of the College of Surgeons.

In the Paris Museum there is a skeleton of the American Manatee which M. Geoffroy carried off from the Museum of Aguda during the occupation of Portugal by the French (see Blainv. *Ostéog.*, *Manatus*, p. 135). The special habitat of this specimen is not known; but it is most probably from the Brazils, that being a Portuguese possession. It is rather more than 6 feet long. This skeleton formed the material of Cuvier's description and figure of the American Manatee in the '*Ossements Fossiles*' (v. t. 19. f. 1, 2, 3)*, and of the figures of the skeleton, skull, and teeth of that animal in Blainville's '*Ostéographie*' (*Gravigrades*), *Manatus*, t. 1, 3, 5.

The front of the skull of Cuvier's figure of this specimen is copied by Dr. Harlan, t. 13. f. 5; and the skeleton and skull are copied into F. Cuvier's '*Hist. Nat. Cetacés*,' t. 2. f. 1, 2, and t. 3 (1836).

De Blainville's figure of the skull, separate from the skeleton, is much narrower and longer than Cuvier's figure of the same specimen in the Paris Museum, and far longer than any skull I have seen. Cuvier's figure is not a bad representation of our skull from America.

Cuvier (*Oss. Foss.* v. 243) describes a young specimen, sent from Cayenne, rather more than 3 feet long.

In the '*Philosophical Transactions*' for 1821 Sir Everard Home described and figured the animal and skeleton of the Manatee of the West Indies, sent by the Duke of Manchester from Jamaica (the skeleton is in the Museum of the College of Surgeons), to show the differences between it and the skeleton

* By mistake, at p. 255 the references to the figures are reversed.

of the Dugong of the East-Indian seas. The paper and plates are reproduced in his 'Lectures on Comparative Anatomy' (vol. iv. t. 55, 56). This is the best figure of the entire animal that I have seen. The next best is that of the Manatee of the Orinoco, figured in Wiegmann's 'Archiv' for 1838, where the form of the mouth of the living animal and the horny plate on the outside of the grinders in the lower jaw are shown.

In the 'Journal of the Academy of Natural Sciences of Philadelphia' for 1823 (vol. iii. t. 13) Dr. Harlan described and figured the skull of a young Manatee procured from the coast of Florida, which he regarded as a new species, under the name of *M. latirostris*. He copies the front part of the skull of *M. australis* and *M. senegalensis*, in Cuvier's 'Ossemens Fossiles,' for comparison with the skull he figures; and M. de Blainville, in the 'Ostéographie' (t. 3), copied his figure of the front part of the skull of *M. latirostris* for comparison with his figure of the skull of the young Manatee from Cayenne, which M. de Blainville considers the same as that figured by Dr. Harlan.

In the Paris Museum there is the skull of a young animal without teeth, which was sent from Cayenne by M. Plie, and is figured by M. de Blainville, in his 'Ostéographie,' t. 3, as *Manatus latirostris*.

In the Leyden Museum there is the skeleton of an American Manatee which was examined by M. de Blainville, and of which he figured the cervical vertebræ, the sternum, and ischium in his 'Ostéographie,' t. 3.

Prof. Schlegel, in his 'Abhandlungen' for 1841, figures the skulls of two specimens which had been received from the Pari-maribo River (t. 5. f. 4-6). The smaller is 12, and the larger 13½ inches long.

Prof. W. Vrolik describes and figures the skeleton of *Manatus americanus* in the 'Bijdr. tot de Dierkund' for 1851, which is probably the same as that examined by De Blainville and figured by Schlegel.

Dr. Ferdinand Kraus, in Müller's 'Arch. f. Anat.' for 1858, p. 390, describes the osteology of the Manatees from Surinam, chiefly from the Mariwyne River. In the paper he gives the measurements of seven skeletons and four skulls which had been supplied to different museums, viz. skeletons at Stuttgart, at St. Petersburg, Copenhagen, Tübingen, Würzburg (a female), Freiburg, and Berlin; and skulls at Stuttgart, Tübingen, and Freiburg. The cervical vertebræ in all are 6; the dorsal vertebræ vary from 16 to 17, the lumbar from 1 to 3; the caudal vary from 24 to 28 (p. 425).

Dr. Kraus observes that the length of the nasal cavity, as compared with its width, is subject to great variation, and con-

firms this observation by the measurements of several skulls. He does not believe that it affords a good specific difference. In young specimens the nose is wider, because the facial part of the skull is not so much protruded longitudinally (p. 406). The nasal bones appear to vary in their position and relation to the adjoining bones (p. 404). It is not impossible that the position of the nasal bones may be used hereafter as a specific character in the American Manatees; and therefore he describes the two extreme forms which he has observed among ten skulls (p. 404). In one the nasal bone is like those in the skull of the *M. senegalensis* figured by De Blainville, and in another it is like that in the skull figured by him as *M. latirostris*.

The British Museum has, through the kindness of Dr. Kraus, a skeleton from Surinam, from this series.

As regards the African Manatees, Cuvier, in the 'Oss. Foss.' v. 255, gives the following as the differences between the skulls of the two species, and also the measurement of their parts:—

"1. La tête d'Amérique est plus allongée à proportion de sa largeur.

"2. Cet allongement appartient principalement au museau et aux narines.

"3. La fosse nasale est trois fois plus longue que large dans le lamantin d'Amérique. Sa largeur fait les trois quarts de sa longueur dans celui du Sénégal.

"4. Les orbites de ce dernier sont plus écartées.

"5. Les fosses temporales sont plus larges et plus courtes.

"6. Les apophyses zygomatiques des temporals sont beaucoup plus renflées.

"7. En revanche elles ont moins de hauteur.

"8. La partie extérieure de la mâchoire inférieure est courbée; dans l'espèce d'Amérique elle est droite" (p. 256).

The front part of Cuvier's figure of the skull is copied by Dr. Harlan; and the figures of the skull are copied by Schreber (Säugeth. vii. t. 380. f. 1, 3, 4, and t. 381).

In the 'Compt. Rend. Acad. Scien. Paris,' vol. ii. for 1836, p. 363, and in the 'Institut,' vol. iv. p. 114, M. Robert makes some observations on the skeleton of the "Lamantin du Sénégal."

In the 'Proceedings of the Boston Society of Natural History,' vol. ii. for 1847, p. 198, Mr. Perkins gives an account of a *Manatus* from the West Coast of Africa, named *M. nasutus* by Dr. J. Wyman; and in the third volume of the same Journal for 1830, at p. 192, Dr. J. Wyman describes the cranium of *M. nasutus*.

M. de Blainville, in the 'Ostéographie,' t. 3, figures the skull of the Senegal Manatee, which appears to be the same as that figured by Cuvier, and the lower jaw (t. 1) and the vertebræ (t. 5)

from an unmounted skeleton of a female that was sent from the Governor of Senegal to the Paris Museum (t. 3. f. 13).

At the meeting of the British Association for 1856 (Trans. of Sections, p. 98) a description of the *Ajuh*, a kind of Whale found in the River Benué by Dr. Vogel, was read by Dr. Norton Shaw; Prof. Owen considered this to be distinct from the Manatee of Senegal, and named it *M. Vogelii*. An abstract of this paper appeared in the 'Institut,' 1857, p. 61.

Dr. Baikie, in the 'Proceedings of the Zoological Society' for February 1857, described and figured the head of a Manatee from the mouth of the Kworra and the Niger, which had been called *Manatus Vogelii* by Prof. Owen. Dr. Baikie draws the following deductions:—"1st, that in the Kwóra or Niger, and its tributary, the Tsádda or Binuë, is found a *Manatus* intermediate in many of its characters between *M. australis* [of America] and *M. senegalensis* [of West Africa]; and 2ndly, that if these differences are, as Prof. Owen suggests, too marked for a mere variety, then there is no alternative but to allow it as a species" (Proc. Zool. Soc. 1857, p. 33; Mammalia, t. 51). The skull of the *Ajuh* (*M. Vogelii*) here described is now in the British Museum collection.

In the Appendix to M. Du Chaillu's 'Travels in Equinoctial Africa,' he mentions a Manatee, found near the Gaboon, under the name of *M. Owenii*.

Four skeletons from the mouth of the Gaboon, purchased from M. Du Chaillu, are in the British Museum; and there is one from M. Du Chaillu in the Museum of the College of Surgeons.

In the 'Proceedings of the Zoological Society for 1857' (p. 59) I published some observations on the species of Manatees; and in the 'Ann. and Mag. of Nat. Hist.' for July 1861, p. 64) in my notes on the animal described by M. Du Chaillu, I made some further observations on the subject. In these papers I stated that I believed the Manatees from America and Africa were distinct species, and attempted to point out the characters in the skull which separated them, and that I believed also, from the examination of skulls from various parts of America and those from the mouths of the different rivers on the West-African coast, that there was only a single species from each of those countries. The characters which I pointed out in these papers, for separating the skulls from the two countries, will, since we have received a larger series of them, require modification; for the effect of the larger series is to make the distinction founded on the form of the parts of the skull more difficult, as the skulls from Africa and America are found to vary in the same manner.

I have examined the following specimens :—

A skull from Cuba, presented by Mr. H. Christy to the British Museum ; and a skeleton obtained at the same place, presented by Mr. H. Christy to the Museum of the College of Surgeons.

A skeleton from Surinam, in the British Museum.

A skull from Jamaica, obtained from Mr. Gosse's collection.

A skull from the West Indies.

A skull in the British Museum, and two skulls in the College of Surgeons, without any habitat, but which are most probably from America.

The skeleton of the young animal, from Jamaica, figured by Sir E. Home, in the College of Surgeons.

Five skeletons and two skulls from West Africa, from the mouth of the Gaboon, purchased from M. Du Chaillu, and named in his work *M. Owenii*.

An imperfect skull of the *Ajuh*, obtained from the River Kworra, by Dr. Vogel, presented by Dr. Baikie. Named *M. Vogelii*.

The genus is confined to nearly the same latitudes on the American and African sides of the Atlantic—that is to say, between 10° south and 25° north of the equator.

From the examination of the skulls and skeletons, I believe that the Manatees living in Africa and America are specifically distinct from one another.

The most prominent characters that separate the species are as follows :—

1. *M. senegalensis*.

The skull without any nasal bones; or the nasal bones, if present in the flesh, are not contained in a pit in the sides of the frontal and maxillary bones. The front edge of the frontal rounded and thick, forming an arched hinder margin to the nasal opening. The lower part of the gonys of the lower jaw convex, rounded, prominent. The front upper incisive edge of the lower jaw concave, with raised edges, with two small separate conical tubercles fitting into a pit in the upper jaw.

The species includes *M. senegalensis*, Desm., *M. nasutus*, Wyman, *M. Vogelii*, Owen, *M. Owenii*, Du Chaillu.

2. *M. americanus*.

The skull with distinct, thick, subcylindrical nasal bones inserted in a notch on the side of the front edge, and a groove in the upper margin of the frontal bone; front margin of the frontal bone transverse, thin, ragged or toothed. The lower part of the gonys of the lower jaw with a compressed bifid prominence, which is often rugose. The front upper edge of the

lower jaw flat, with a central, large, conical or compressed, acute tubercle fitting into a pit in the upper jaw.

The species will include *M. australis*, Tilesius, *M. americanus*, Desm., *M. latirostris*, Harlan, *M. fluviatilis*, Illiger.

The ribs of the African *M. senegalensis* are slender and compressed; the sternal end is thicker and much narrower than the middle part of the rib, but rather compressed and higher than thick. In the American *M. americanus* the ribs are very thick, solid, and heavy, compressed and broad in the middle, and nearly cylindrical at the sternal end.

The characters above given are the result of a generalized description of the skulls from each country, rather than a rigid individual description of any of them.

The nasal bones are absent in all the African skulls, and there is no appearance of any notch in the front edge of the frontal bone, or groove in the upper margin of that bone on the edge of the nasal opening; so that if there is a nasal bone in the flesh, it must be free from the other bones.

The nasal bone is absent also in M. de Blainville's figure of the skull from Senegal, in the Paris Museum.

On the other hand, there is a distinct nasal bone, or a notch in the outer edge of the first of the frontals, and a groove for its reception, in all the skulls from America in the British Museum; but the size of the bone appears to vary greatly in these specimens.

It is present, on one side, in the figure of the skull named *M. latirostris*, from Cayenne, in M. de Blainville's 'Ostéographie,' and in Dr. Harlan's figure of *M. latirostris* from Florida. Dr. Kraus states that the size and form of the nasal bone were very variable in the specimens of Manatees that he received from one locality (Surinam); and they are not present in the skulls of *M. australis* and *M. latirostris* in the Paris Museum, if we are to depend on M. de Blainville's figures; nor are the notches or grooves to be seen in these figures, and they are absent in the skull of the skeleton from Cuba in the College of Surgeons.

In the skulls of the African Manatee in the British Museum and in M. de Blainville's figure of the skull at Paris, from Senegal, the hinder or upper margin of the nasal aperture is contracted, and the front edge of the frontal bone is thick and rounded. The width of the arch of the upper edge of the nasal aperture varies in these species; in one it is narrow and ovate, in another broader, and in the third much broader and nearly straight-edged.

In all the skulls from America the front edge of the frontal bone is truncated, with a more or less thin, straight edge, which

is rugged or produced into teeth between the notches on the sides. But in one of the African skulls the front edge of the frontal is truncated, thin, and torn, as in the American skulls; but this has not any notch on the side for the reception of the hinder ends of the nasals.

The character of the form of the gonys of the lower jaw is more variable and less distinctive. In four lower jaws from Africa the gonys is convex, rounded, and but slightly grooved; and in three of the lower jaws of the skulls from America the gonys is much more produced, compressed, and divided into two rugosities by a central groove. Yet in one of the lower jaws from Africa there is a slight indication of an approach to the form of the tubercle in the American jaws; in one of the American lower jaws the tubercle of the gonys is scarcely divided, and less developed than in those above described, and in another American lower jaw the tubercle is so like that of the African specimen as not to be distinguished from it.

The tubercle or tubercles in the front of the upper surface of the incisive part of the lower jaw appear to be constant in the specimens in the British Museum. They vary in size according to the age of the specimen, being least developed in the younger ones.

The flatness or concavity of this part of the lower jaw is not so distinctive; it is very concave in all African skulls, and flat in the American ones; but the sides are more or less raised in the different specimens. But, combined with the form of the tubercle, it affords some assistance in determining the species.

In all the African skulls the lower part of the aperture of the nose is above a line drawn across the beak of the skull on a level with the surface of the alveoli of the teeth. In all the American skulls the aperture is similarly situated as regards such a line; but in one (the specimen from Jamaica), with a very largely developed intermaxillary bone, the lower edge of the nasal aperture is just on a level with such a line.

After the most mature consideration and comparison of the specimens from the different parts of Africa and America, and the comparison of the figures on which the presumed species from each of these countries have been founded, I have come to the conclusion that, as far as the material at my command will allow me to form an opinion, there is but a single species in each locality. The species in each country vary in the size and shape of the nasal cavity, in the length of the rostrum of the skull, and the angle at which it is bent in regard to the line of the palate, and also in the size and form of the intermaxillary bones, and this even in specimens from the same locality, as is proved by the observations of Dr. Kraus on the specimen from Surinam.

The lower jaw is very apt to vary, in both species, in the form of the coronoid process, which is sometimes broad, at others narrow, and placed at very different positions as regards the ramus, as is illustrated by the skulls in the British Museum.

Of the two skulls that are most unlike, one comes from Jamaica, and the other from Cuba. I am therefore induced to believe that they may be the sexes of the same species. These are both the skulls of adult animals, having seven developed teeth on each side, and another visible or nearly ready to come up. The one from Jamaica has the beak of the upper jaw wide at the base and much dilated in the middle, and the intermaxillary bones very large and solid, the plate of the maxillary bone under the orbit very broad—much broader than in any of the other skulls; but they are unequally broad on the two sides. The other skull from the West Indies, on the contrary, has a moderately short beak, only a very little longer than the tooth-line; it is bent up from the tooth-line at a very obtuse angle. The bones of which it is formed are much smaller and less massive. The palatine surface is contracted at the base, and rather dilated on the sides. A third skull of an adult animal, from Cuba, is almost intermediate between the one from Jamaica and that from the West Indies in the length, angle, and solidity of the rostrum, and also in the form of the palatine surface of the beak.

The following are the measurements of the skulls in the British Museum:—

	Length of skull.		Length of rostrum below.		Length of rostrum above.		Width at zygoma.		Width at middle of orbits.		Width at intermaxillary side-suture.		Length of front intermaxillary suture.		Length of nose-aperture.		Width of nose-aperture.		Length of lower jaw.		Length of upper symphysis.		Length of lower symphysis.	
<i>M. Americanus.</i>	in.	l.	in.	l.	in.	l.	in.	l.	in.	l.	in.	l.	in.	l.	in.	l.	in.	l.	in.	l.	in.	l.	in.	l.
Cuba	16	35	7	4	3	9	10	5	6	2	2	3	0	6	3	4	0	11	2	2	10	3	10	
West Indies	14	64	6	5	3	9	2	5	3	2	1 $\frac{1}{2}$	3	0	5	1	3	10	9	7	2	11	3	7 $\frac{1}{2}$	
Jamaica (imperfect)...	...	...	5	5	...	6	6	2	7	3	9	6	3	4	7	10	6	3	3	3	9		
Surinam	12	103	3	11	4	4	8	24	3	1	7	2	1	5	7	2	6	8	4	2	2	3	0	
Hab.unknown (young)	11	43	10	4	1	7	6	4	7	1	6	2	2	3	11	3	3	7	3	2	4	2	6	
<i>M. Africanus.</i>																								
Gaboon (B.)	14	33	11	4	9	9	0	5	3	1	10	2	2	5	6	3	9	9	1	2	3	3	6	
Gaboon (E.)	13	43	6	4	5	8	5	3	1	11	2	3	5	4	3	7	8	9	2	1	3	0		
<i>M. Vogelii</i> (D.)	11	93	6	3	9	...	4	6	1	5 $\frac{1}{2}$	1	11	4	4	3	1	7	9	1	9	2	11		
Gaboon (A.)	13	34	14	4	...	4	6	1	8 $\frac{1}{2}$	2	0	5	1 $\frac{1}{2}$	3	1 $\frac{1}{2}$	8	8	1	11 $\frac{1}{2}$	2	9 $\frac{1}{2}$			
Gaboon (C., set up)...	13	64	3	5	0	9	8	6	0	2	0	2	9	5	16	4	0	10	0	2	9	3	6	

When Cuvier had a skull of the American and one of the African Manatee, he gave eight characters by which the African skull could be known from the American. Now we have a series of skulls of each kind, we find that not one of these characters

will separate the skulls of the two countries from one another. Indeed the skulls of each kind are so variable that, after having them laid out before me for two or three days, studying them every now and then, and inducing two proficient in the study of bones and in observing minute characters, to give me their assistance, we came to the conclusion that we believed there was no character, common to all the skulls of each kind, which could be used to separate them. As a proof of the difficulty of so doing, I may state that there was one skull in the series which had been long in the Collection, and had been received without any habitat, and neither of the three could decide to which of the series this skull should be referred; and it was not until I accidentally observed the character derived from the absence of the nasal bones in the African kind that this question could be settled. It may be asked, Why was not the absence or the presence of the nasal bones observed earlier in the examination? The reply is easy: these bones are anomalous in the genus, being small, far apart, and easily lost; for they were only present in one of the skulls, and their existence in the other American skulls is only proved by the scar, or rather groove which is left in the bones; and though they are not found in the skull of the African Manatee, we have no proof that they are not free in the flesh of the nose in that species.

The examination of a large series of skulls of the Bears (*Ursus*) and *Paradoxuri* shows how difficult it is to distinguish species by the study of the skulls alone. Thus, when we have a series of skulls of Bears from different localities, which, from their external form and habits, are known to be distinct species, it is easy to say which is the skull of *U. tibetanus*, *U. syriacus*, *U. arctos*, *U. cinereus*, and *U. americanus*, when we have the habitat marked on each; but the true test of the power of distinguishing the one from the other is to determine to what species a skull belongs, of which we have no information as to its origin; and we have several skulls in the British Museum under these circumstances, and I cannot, even with the best assistance at my command, determine to which species they ought to be referred. And it is the same with the skulls of the *Paradoxuri*. I have observed, in a large series of skulls, that there is, in some genera at least, more difference between the skulls of the same species from the same locality than there is between two species from different localities which are well established by external characters.

If this is the case with skulls (and I particularly allude to them, as they are generally regarded as the most characteristic bones of a skeleton, and are therefore the bones most usually studied by zoologists), how must the difficulty of distinguishing species with certainty be increased when we have only fossil bones,

which are generally more or less imperfect, to examine and compare, or of which only a limited number of examples are to be obtained and compared?

By these observations I by no means wish to throw any doubt on any determinations which have been made, or to deny that there are well-determined fossil species, but merely to show the necessity of extreme caution in determining fossil bones as well as recent ones, and to point out that, in some cases at least, it is not sufficient to compare a recent skull, much less a fossil one, with one entire skull, and then determine whether it is a new or an extinct species—more especially as such abstruse questions as the antiquity of Man and other theoretical questions have been attempted to be settled by the results of such examinations.

The skulls of certain genera seem much more liable to vary than those of others. They vary in most genera much more than was expected before series of the skulls of each species were collected and compared. It must be observed that these variations of the skull do not in the least prove the want of distinctness between species, but only show that the bones are as liable to vary as any other part of the body. Nor does it in the least detract from the importance of studying the bones in connexion with the external characters.

In some genera, where a very similar kind of colour is common to all the species, and where the colours seem to show an inclination to run into one another, as in the four species of *Helictis* from Java, Nepaul, China, and Formosa, the examination of the skulls at once shows that the species are really distinct, and may be divided by the skull into two most distinct groups.

XVI.—*Descriptions of Species of Phytophaga received from Pulo Penang or its Neighbourhood.* By the Rev. HAMLET CLARK, M.A., F.L.S.

Subfam. Eumolpidæ.

Genus CORYNŒIDES.

Generi *Corinodi* (Hope, Marshall, "Corynodor. recensio," Linn. Soc. Journ. Zool. vol. viii. p. 25) valde affine. *Caput* verticale. *Oculi* pene circulares (vix oblongi) et ad latus haud sinuati sed excavati. *Antennæ* ut in genere *Corynode* positæ, sed valde elongatiores; in ♀, corporis dimidium longitudine superantes; in ♂, corporis longitudinem pene attingentes: in ♂ articulus 1^{mus} globosus, 2^{dus} brevis; ceteri elongati, subcylindrici, ad apices incrassati; in ♀ articuli breviores, et 7–11 compresso-latiores (haud ut in *Corynode* latissimi, et pene transversii, sed elongatiores), formam articulorum

3^{ti} et 4^{ti} et 5^{ti} retinentes, sed compressi, et incrassati. *Palpi maxillares* elongati, articulo ultimo producto, et apice acuminato, haud ut in genere *Corynode* truncato. *Thorax* subcylindricus, transversus, ad latera marginatus. *Scutellum* subcordiforme, satis magnum. *Elytra* thorace latiora, parallela, subcylindrica, convexa, lateribus versus apicem approximantibus, marginatis, et in ♀ apice ipso undique tuberculatis. *Elytra* in ♂ lævia, in ♀ vehementer tuberculata. *Pedes* robusti, tibiis ad apicem dilatatis, tibiis posticis ad apicem intus canaliculatis: *unguiculi* appendiculati.

Typus *Corynoeides tuberculata*.

Although the genus *Corynodes*, as laid down by Mr. Marshall in his excellent paper in the Journal of the Linn. Soc., contains evidently within its limits forms which vary considerably among themselves in the degree of the dilatation of the antennæ (and also, to a less degree, in the amount of development of the inner claw of the unguiculi), I have no doubt whatever that the following species constitutes the basis of a quite separate though adjoining genus. In the first place, there is a most remarkable difference of form in the antennæ of the two sexes: those of the ♂ are hardly, if at all, compressed as in *Corynodes*, but are robust and generally filiform, and approximating in length to that of the whole body; while those of the ♀ (though considerably longer than in the genus *Corynodes*) are shorter than those of the ♂, and somewhat compressed and dilated in the apical joints; the *eyes* are apparently less oblong, more circular, and more manifestly excavated (not sinuate) at their inner margin; the *thorax* is not elongate or compressed in front, but transverse; the *elytra* are more cylindrical and elongate, less attenuate near the apex; and, especially, there is in the *surface of the elytra* a difference of character between the two sexes, which not only is different from the habit of *Corynodes*, but is almost unique among the whole of the vast and varied group of Phytophaga. In the males the surface is smooth, after the usual type; in the females, however, the whole elytra are adorned with several well-developed tubercles, obsolete towards the apex, but bold and prominent nearer the base. These special differences of detail, coupled with a generally distinct facies, require us to erect for the beautiful species before us a separate genus.

C. tuberculata, n. sp.

C. ovalis, elytris in ♀ tuberculatis, in ♂ simplicibus, punctata, læte cyanea: *caput* inter oculos arcuatim impressum, et ad verticem longitudinaliter foveatum; ad frontem punctatum, cyaneum, infra antennarum basin cæruleum: *antennæ* in ♂ elongatæ, simplices, in ♀ juxta apicem compressæ et breviores; art. 1-6 cyaneis, 7-11 cæruleis: *thorax* transversus; latera undique leviter marginata apparent, crebre punctata: *scutellum* subcordiforme, læve

(*subtilissime* et sparsim punctatum): *elytra* in ♂ punctata, in ♀ crebre tuberculata (tuberculis ad latera exstantibus, ad suturam post medium oblitteratis, sed juxta humeros valde prominentibus): *corpus subtus* viridi-cyaneum: *pedes* validi, viridi-cyanei.

Long. corp. lin. $5\frac{1}{2}$ –6; lat. lin. $2\frac{3}{4}$.

I received an example of this species from Mr. Stevens, a few weeks ago, a ♀ of a bright burnished *green* colour. Since then, by the kindness of Mr. A. R. Wallace, I have had the opportunity of examining a series of both sexes of the species, the uniform colours of which were blue. Very happily, the gentleman who collected these specimens must have found examples *in coitu*, for they were carefully labelled by him as males and females; and hence we have the authority of the captor for the remarkable fact that the two different forms are the sexes of one and the same insect.

In the cabinets of Mr. Baly and the Rev. Hamlet Clark.

Hab. Pulo-Penang.

Genus RHYPARIDA, Baly (Journ. Entom. i. 286).

1. *R. atripennis*.

R. lata, punctato-striata, nitida, rufa, elytris nigris: *caput* punctatum, rufum; oculi ad margines interiores sinuati: *thorax* transversus, sat rotundatus, lateribus rotundatis et versus caput constrictis, ad latera tenuiter marginatus, punctis satis fortibus sparsis (ad angulos anteriores obsoletis) ornatus; margines anterior posteriorque fovea tenui punctorum notantur: *scutellum* elongato-triangulari, nitidum, impunctatum: *elytra* thorace latiora, brevina, lateribus parallelis et subsinuatis, apud humeros breviter angulata, ad apicem rotundata, punctato-striata; stria 6^{ta} apud basin fortiter sed breviter foveatur, ita ut humeri ipsi rotundati extant: *antennæ* sat tenues, pallide testaceæ, articulus basalis rufo-testaceus: *pedes* et *corpus subtus* rufa.

Long. corp. lin. $3\frac{1}{2}$; lat. lin. $2\frac{1}{3}$.

In my own cabinet and that of Mr. Baly.

Hab. Penang.

2. *R. rufa*.

R. lata, parallela, brevis, nitida, leviter punctato-striata, rufa, nigro maculata: *caput* punctatum, rufum; *antennæ* graciles, filiformes, flavo-rufæ: *thorax* transversus, antice rotundatus, ad latera undique marginatus, punctatus, rufus: *scutellum* elongato-subtriangulari, nitidum, rufum: *elytra* brevina, thorace latiora, humeris prominulis; leviter punctato-striata, nitida, rufa, humeris (anguste) et apice (late) nigris; macula apud apicem transversa versus humeros oblique extendit: *pedes* flavo-rufi: *corpus subtus* rufum.

Long. corp. lin. $4\frac{1}{2}$; lat. lin. 3.

In my own cabinet and that of Mr. Baly.

Hab. Pulo-Penang.

Genus COLASPOIDES, Laporte,
Baly (Ent. Monthly Mag. 1864, 134).

C. pulchella.

C. ovalis, punctata, læte cærulea, nitida : *caput* verticale, inter oculos transverse depressum iterumque ad frontem longitudinaliter foveolatum, punctatum, punctis rarius versus frontem conspersis, viridi tinctum : *thorax* superne visus transversus, lateribus ipsis versus caput obliquatis et depressis, margine anteriore rotundato, posteriore sinuato-marginato, lateribus undique tenuiter marginatis, thorax leviter sed satis dense punctatus : *scutellum* ad apicem circulare, læve : *elytra* parallela, robusta, thorace latiora, punctata (punctis ad dorsum crebris et fortibus, versus apicem minoribus et in strias sese formantibus) ; margines elytrorum nigri apparent : *antennæ* nigrae : *pedes* viridi-nigri : *corpus subtus* viride, abdominis segmentis rarius punctis ornatis.

Long. corp. lin. $2\frac{1}{2}$; lat. lin. $1\frac{1}{2}$.

Hab. Pulo-Penang.

The differences of structure between *Colaspoides limbata*, Oliv., the type of the genus, and the species before us do not appear to be sufficient to separate them generically, although the former belongs to a group which is sufficiently abundant in examples and species in Brazil, while the latter is one of exponents which are probably distributed through a large portion of the Eastern Archipelago.

Genus COLASPOSOMA, Lap.

1. *C. æneo-viride.*

C. parallelum, latum, robustum, breve, punctatum, nitidum, æneo-viride : *caput* ad frontem longitudinaliter depressum, fortiter punctatum : *thorax* transversus, ad latera juxta frontem valde depressus, lateribus subrectis, versus apicem paulum contractis, marginatis, basi etiam subsinuata, marginata ; thorax fortiter punctatus ; *scutellum* subcordiforme, lævi, viridi-æneum : *elytra* subparallela, robusta, humeris prominulis, lateribus vix versus apicem contractis, marginatis ; elytra punctato-striata ; puncta minuta, satis crebra, confuse (sed versus apicem in striis vix æqualibus) ordinantur : *antennæ* rufo-fuscae : *pedes* nigri, tibiis tarsisque rufo-fuscis : *corpus subtus* nigrum.

Long. corp. lin. $4\frac{1}{2}$; lat. lin. 2.

Hab. Pulo-Penang.

2. *C. metallicum.*

C. breve, robustum, ovale, nitidum, fortiter et crebre punctatum, æneo-metallicum : *caput* verticale, punctis confertis : *thorax* transversus, lateribus subrotundatis, marginatis, angulis anterioribus compressis, margine anteriore transverso, postico sinuato ; ad mediam basin fovea minuta longitudinalis apparet ; thorax punctatus,

punctis minutis inordinatis sat confertis : *scutellum* subcordiforme, paucis punctis ornatum : *elytra* brevia, robusta, ad apicem late rotundata, marginibus paulum sinuatis (humeri ob depressionem obliquam post-humeralem satis extant), punctata ; puncta haud thoracis puncta magnitudine æquant, sed magna, præsertim juxta margines (qui rugosi apparent), et conferta, juxta apicem strii disponuntur : *corpus subtus*, *pedes* et *antennæ* nigra.

Long. corp. lin. 3 ; lat. lin. 2.

C. metallicum is a smaller insect than *C. æneo-viride* ; the punctures differ in the two species in size, and the antennæ and legs in colour.

Hab. Pulo-Penang.

Subfam. GALLERUCIDÆ.

Genus RHOMBOPALA, Chevr.

Genus Gallerucidarum *Adorio* affine, sed species plerumque statura grandiores, latiores, et rotundatiores. *Caput* verticale, pene reconditum. *Palpi maxillares* ad apices globosi, articulo penultimo incrassato, brevi, quasi subconico (haud cylindrico ut in *Adorio*), articulo ultimo brevi, et lato. *Antennæ* simplices, satis robustæ, et breves, articulis ultimis haud 2^{ndum} longitudine superantibus. *Thorax* brevis, haud ut in *Adorio* ad basin recte transversus, sed late inflectus vel arcuatus ; latitudine vix singulum elytrorum superans. *Scutellum* subtriangulare. *Elytra* lata, robusta, rotundata, brevia, parvum corpus amplitudine complectunt. *Pedes* robusti, unguiculis undique bifidis.

This genus is a very natural one ; its representatives may at once be separated from those of *Adorium* by their generally larger size, their more broadly ovate form, their shorter and more robust antennæ, and the globular form of the maxillary palpi ; the species composing it are found in China, Java, and the East Indies.

1. *R. duodecimpunctata*, Chevr.

R. latissima, subtiliter punctata, pallide flava, nigro maculata : *caput* breve, ad frontem transverse arcuatim depressum : *thorax* transversus, arcuatus, impunctatus, pallide flavus ; ad medium undique macula nigra insularis subcylindrica apparet : *scutellum* triangulare, impunctatum : *elytra* lata, ad latera amplissima, subtiliter punctata, undique maculis 6 ornata, ordine dispositis (3 juxta suturam, tresque aliæ oppositæ juxta latus), insulatis, circularibus, magnis ; iis ad suturam plerumque illas apud latera magnitudine superantibus : *antennæ* pallide testaceæ, art. 10^{mo} et 11^{mo} fuscis.

Long. corp. lin. 5½ ; lat. lin. 4.

I have received this very conspicuous species from Chevrolat's collection, who obtained examples of it from Siam.

2. *R. pectoralis*, Chevr.

R. pallide testacea; capite, pedibus et pectore subtus nigro-fuscis: *caput* inter oculos arcuatim depressum, nigrum: *antennæ* art. 1-6 nigro-fuscis, art. 1-5 ad interiorem partem testaceo adumbratis (7-11 desunt): *thorax* lævigatus: *elytra* sparsim sed haud profunde punctata: *pedes* et *corpus subtus* nigra, abdomine autem testaceo.

Long. corp. lin. $4\frac{1}{2}$; lat. lin. $3\frac{1}{3}$.

Received from Siam by M. Chevrolat, from whose collection I obtained the species.

Genus OCHRALEA (Chevr., ined.).

Corpus ovale, sat elongatum, nitidum, fere haud punctato-striatum, subtiliter punctatum, et omnino vel flavum vel rufo-flavum. *Caput* verticale; *oculi* ovati; *palpi maxillares* articulo penultimo quadrato, ultimo producto, acuto. *Thorax* depressus, *subquadratus* (haud transversus); latera nec recta sunt, nec subrecta (ut in *Adorio*), sed distincte rotundata. *Scutellum* triangulare. *Elytra* subparallela et elongata, vix apud medium ampliata. *Pedes* sat graciles; unguiculi ad basin plus minus appendiculati sunt, haud ut in *Adorio* undique biunguiculati. *Corpore subtus* mesosterni parapleuræ elongato-triangularis, pleuris ipsis vel obsoletis vel tenuibus.

The genus *Ochralea*, proposed by Chevrolat, appears to be a very natural one, and of much more easy definition than the species themselves that compose it. It is nearly allied to *Adorium*, but may be readily separated from it, not only by its general form (more elongate and narrower), but by its maxillary palpi, the apical joint of which is elongate and pointed at the apex, not short and rounded as in *Adorium* (cf. Oliv. Hist. Nat. viii. plate 92 *bis*, 1 *e*); its *thorax* is less transverse; the unguiculi of the feet are not bifid, as generally in the species of *Adorium*, but appendiculate; and on the under side of the body the parapleuræ are more elongate, and the pleuræ of the mesosternum, which in *Adorium* give a posteriorly rounded form to the parapleuræ, are here almost obsolete.

O. nigricornis.

O. elongato-ovalis, subtilissime punctata, pallide testacea, nitida; antennis ad apicem, tibiis tarsisque nigris: *caput* longitudinaliter iterumque transverse inter oculos foveatum est, impunctatum: *thorax* subquadratus, angulis anticis late rotundatis et marginatis, subtilissime punctatus: *scutellum* triangulare, impunctatum: *elytra* thorace latiora, subparallela, tenuiter punctata: *antennæ* graciles, flavæ, art. 10^{mo} et 11^{mo} fusco-nigris: *pedes* flavi, tibiis tarsisque nigris.

Long. corp. lin. 5; lat. lin. $2\frac{3}{4}$.

The four or five different Eastern exponents of this form seem

almost to resolve themselves into one species. There is very little, except modifications of colour, to separate *O. flava*, Oliv., *O. nigripes*, Oliv., *O. rubiginosa* of European cabinets (which has been taken abundantly by Mr. Wallace), and the species before us; and, moreover, two of the patterns have an extended geographical range. *O. nigripes*, Oliv., from Bengal, is identical with a species taken in the Philippines, and *O. flava*, Oliv., from the East Indies, is found also in Celebes and China; inasmuch, however, as there is a *constancy* in these varieties of pattern, and as Olivier's description consists of a few words only, I have thought it well to describe more fully the Penang form.

In my own cabinet and that of Mr. Baly.

Genus AULACOPHORA (Chev.).

Elongata, ovata (versus apicem plerumque ampliata), in specierum plurimis subtiliter punctata, nigra, vel nigro-rufa vel flavo ornata: genus passim et abundanter in regionibus orientalibus occurrans. *Caput* verticale, vel pene verticale, productum; *palpi maxillares* articulo penultimo incrassato, rotundato, subcylindrico, interdum versus apicem ampliato, ultimo brevi, minore, conicali. *Thorax* capite lator, elytris angustior, transversus, lateribus plerumque sinuatis, et disco apud medium transverse foveolato. *Scutellum* triangulare. *Elytra* vix vel rarius parallela, latera subsinuata sunt, versus apicem ampliata, plerumque leviter punctato-striata, nitida. *Corpore subtus* mesosterni parapleuræ scaleno-triangulares. *Pedes* satis graciles; unguiculi undique bifidi. *Antennæ* graciles, simplices.

This genus was constructed by Chevrolat for the reception of a very numerous group of Eastern Gallerucidæ. It differs from *Diacantha*, the neighbouring genus of African forms, by its simple antennæ; from *Rhaphidopala*, and other forms near it, that will require the erection of special genera, by its more robust body.

A. simplicipennis, n. sp.

A. elongato-ovata, nitida, nigra, elytris rufis: *caput* impunctatum, supra antennarum basin, ad frontem anteriorem profunde et breviter transverse foveolatum: *thorax* transversus, ad latera et antice marginatus, latera subrotundata, apud medium fortiter transverse foveolatus, sparsim punctatus: *scutellum* elongato-triangulare, nitidum: *elytra* subparallela (apicem versus modice dilatata), subtiliter punctata, rufa: *corpus subtus* nigrum: *pedes* nigri, tarsi pallide rufi: *antennæ* pallidæ, testaceæ.

Long. corp. lin. 4; lat. lin. $2\frac{1}{2}$.

An abundant species at Pulo-Penang.

In my own cabinet and that of Mr. Baly.

Genus GONIOPLEURA, Westwood ; Griff. ; Cuv. An. King. Ins. ii. 149, pl. 67. f. 3.

G. viridipennis.

G. parallela, elongata, tenuiter pubescens, rufa, viridipennis : *caput* crebre punctatum : *thorax* ad apicem haud capite latior, quadratus, ad latera undique apud medium late angulatus, inter hos angulos et basin undique fovea lata obliqua minime profunda apparet ; *thorax* rarius rufo-pubescens, crebre punctatus : *scutellum* subtriangulare, rufum, nitidum : *elytra* parallela, elongata, rarius pube ornata, punctata : *antennæ*, *pedes* et *corpus subtus* rufa.

Long. corp. lin. $8-5\frac{1}{2}$; lat. lin. $3\frac{3}{4}-2\frac{1}{2}$.

This second species of the genus differs from *G. auricoma* not only in pattern, but also in the simple (not rounded or almost bidentate) angle on the margins of the thorax.

I have received the species from M. Deyrolle, who obtained it from Malacca ; a specimen is in Mr. Baly's collection from Penang.

Genus CDECERUS, Redt.* (Hugel's 'Kaschmir,' iv. 556.)

C. rufo-fuscus.

C. tenuis, elongatus, subparallelus, subtiliter punctatus, rufus, elytris fuscis, testaceo adumbratis : *caput* infra antennarum basin transverse foveolatum, impunctatum, pallide flavum : *thorax* quadratus, latera vix inflecta ; margo anterior transverse rectus, posterior subsinuatus ; ad medium discum fossa profunda lata transversa patet ; *thorax* impunctatus, flavus : *scutellum* triangulare, læve, pallide flavum, marginibus fuscis : *elytra* subparallela, elongatula, punctata, punctis parvis et remotis : *antennæ* validæ, breves, articulo 1^{mo} producto, reliquis brevibus, art. 1^{mo} flavo, reliquis fuscis : *pedes* flavi, tibiis tarsisque fuscis : *corpus subtus* flavum.

Long. corp. lin. 2 ; lat. lin. $\frac{3}{4}$.

Hab. Pulo-Penang.

Genus DERCETIS, gen. nov.

Corpus ovatum, latum, depressum. *Caput* subporrectum, breve ; *oculi* ovaes ; *palpi maxillares* elongati, cylindrici, art. penult. brevi, subtiliter incrassato, art. ultimo producto, acuminato. *Thorax* brevis,

* I am indebted to Mr. Baly for the generic determination of this species, and also for a reference to Hugel ; as the work is scarce, it may be well to append here briefly the diagnosis of the genus. *Antennæ* 11-articul. fili-formes, art. 5^o et 6^o difformibus : *labrum* subquadratum, antice rotundatum : *mandibulæ* facie interna excavata, margine dentato : *palpi max.* 4-articulati, art. 3^o 2 primis longiori ; ultimo brevi, acuminato : *tarsi* 4-articulati, art. 3^o bilobo, unguiculis dente late acuto armatis.

The insects composing the genus are in size small, of parallel form, and notable by the peculiar incrassation of the fifth and sixth joints of the antennæ of the male.

transversus, angulis anticis plerumque distinctis, margo anterior modice et late excavatus; thorax capite latior apparet, sed minuta et gracilis elytris comparatus. *Scutellum* triangulare. *Elytra* lata, depressa, ovata, humeris prominulis thorace exstantibus, lateribus modice rotundatis, et apice breviter rotundato, punctata, haud striata. *Pedes* graciles; tarsorum artic. penultimo late bilobato, ultimo producto, unguiculis appendiculatis. *Antennæ* graciles.

Typus *Dercetis depressa*.

1. *D. depressa*.

D. late ovata, nitida, depressa, nigra, ad elytrorum basin undique late flavo plagiata: *caput* super antennarum basin transverse (subarcuate) foveolatum, iterumque ad medium breviter longitudinaliter depressum, impunctatum, nigrum, ore tamen flavo: *thorax* late transversus, angulis anticis prominulis, latera marginata sunt, etiam (tenuiter) margines anterior et posterior; thorax planus, impunctatus, nitidus: *scutellum* triangulare, impunctatum, nigrum: *elytra* lata, ad latera paulum rotundata, nigra, undique plaga subcircularis a margine usque ad suturam, et a basi ad medium elytri totum elytri occupat, margine nigro suturali et laterali plagæ tenui: *antennæ* graciles, testaceæ: *pedes* fusci, tarsis flavofuscis.

Long. corp. lin. $2\frac{1}{2}$; lat. lin. $1\frac{1}{2}$.

Hab. Penang.

2. *D. bifasciata*.

D. nitida, depressa, flava; elytris nigris, fasciis duabus flavis: *caput* super oculos transverse, iterumque ad medium breviter longitudinaliter foveolatum, flavum, basis autem niger est, frons etiam inter antennis fusco adumbrata: *thorax* transversus, angulis anticis subrectis, depressus, marginatus, flavus: *scutellum* triangulare, læve, nigrum: *elytra* late ovata, depressa, punctata (punctis haud profundis), nigra, fasciis duabus flavis ornata, harum una antemedia, alteraque postmedia margines elytrorum haud attinent, apex quoque ipse transverse flavus est: *antennæ* graciles, flavæ: *pedes* graciles, flavi; tibiis tarsisque fusco adumbratis: *corpus subtus* flavum, metasterno autem nigro.

Long. corp. lin. $2\frac{1}{2}$; lat. lin. $1\frac{1}{2}$.

Hab. Penang.

Subfam. GALLERUCIDÆ (HALTICIDÆ).

Genus SEBÆTHE, Baly (Ann. & Mag. Nat. Hist., Dec. 1864, 438).

S. flava.

S. ovata, depressa, punctata, flava, nitida: *caput* inter oculos subtiliter transverse depressum, impunctatum: *thorax* transversus, antice fortiter excavatus, lateribus rotundatis et marginatis, angulis anticis prominulis; thorax lævis, impunctatus: *scutellum* subtriangulare, apice obtuso, et lateribus paulum sinuatis: *elytra* satis

elongata, pene parallela, depressa, subtiliter punctata : *antennæ* flavæ, versus apicem fusco-flavæ : *pedes* et *corpus subtus* rufo-fusca. Long. corp. lin. $2\frac{3}{4}$; lat. lin. $1\frac{4}{5}$.

S. flava differs from *S. badia* of Erichson (on which the genus was based), according to the specimen in Mr. Baly's cabinet : the species before us is smaller in size, the form is more compressed and flat, and the colour of the legs is different.

Hab. Pulo-Penang.

Genus ARGOPUS, Fisch., Allard.

A. angulicollis.

A. latus, satis depressus, subtilissime punctatus, rufus : *caput* ad antennarum basin transverse foveolatum, impunctatum : *antennæ* graciles, art. 1-3 flavis, 4-9 nigris, 10° et 11° testaceis : *thorax* transversus, ad basin arcuatus, frons etiam sinuata (apud medium rotundato-subporrecta) ; latera late marginata, et versus apicem angulata ; thorax punctatus, nitidus : *scutellum* triangulare, læve : *elytra* lata, rotundata, subtiliter punctata : *corpus subtus* nigrum vel nigro-piceum, abdomine rufo : *pedes* nigri.

Long. corp. lin. $2\frac{3}{4}$; lat. lin. 2.

Under the head of *Argopus* will be found ranged in many of our cabinets species from India, the East, Madagascar, and the Cape which clearly require the construction of two or three special genera for their reception. The species before us differs from the true *Argopus*, both in the form of its palpi, its somewhat different appendiculations of the claw, and the peculiar lateral angles of the thorax. I prefer, however, to place it here, at all events provisionally, than to seek to establish a new genus in a difficult and numerous group, on the basis of a single species.

Hab. Pulo-Penang.

In my own cabinet and that of Mr. Baly.

XVII.—On the Literature of English Pterodactyles*.

By HARRY SEELEY, F.G.S., Woodwardian Museum, Cambridge.

THE earliest remains of Pterodactyles yet figured are from the Lias. Professors Buckland, Owen, and Huxley have described the *Dimorphodon*. I therefore approach the subject with diffidence. But my task now is not to describe these remains, but to examine the nature of the work bestowed upon them.

Prof. Buckland's is the only description of the specimen figured in pl. 27, Geol. Trans. ser. 2. vol. iii. ; and the remarks

* Extract from a paper read before the Cambridge Philosophical Society, March 7 and May 2 and 16, 1864.

of Prof. Owen (Brit. Ass. 1858) and Prof. Huxley (Quart. Journ. Geol. Soc. 1859) both refer chiefly to a second specimen in the British Museum.

Dr. Buckland's account of the animal is too meagre to be of much service, and so inaccurate that it is much to be regretted that the eminent anatomists who have written on Pterodactyles have not done justice to remains scarcely less interesting than the *Archæopteryx*.

I will go *seriatim* through such parts of Prof. Buckland's description as need comment.

Neck (marked *a*). The impression of this part of the skeleton, as given in the plate, tapers. The vertebræ are very long, and so slender as to be no thicker than an ordinary phalange, and not half the diameter of the dorsal vertebræ. It is moreover bordered on each side with a band of fine bony tendons. Now, in all the subclass Saurornia known to me, whether of the section *Pterosauria* or *Rhamphosauria*, the neck-vertebræ are not only longer than those of the back, but also, instead of being thinner, they are thicker. Such a neck could not have supported the large head which the *Dimorphodon* possessed. Moreover the broad belt of bony supports on each side of the vertebræ is eminently characteristic of the long stiff tails of the Rhamphosauria, to which the genus *Dimorphodon* belongs; and if these supposed neck-vertebræ are compared with the tail-vertebræ of *Rhamphorhynchus*, they correspond exactly. Therefore what has been described as the neck is really the tail.

Vertebræ. That at C, described as showing a "convex articulating surface, as in the Crocodile," is so broken that nothing can be made of it. Buckland's figure makes it *concave*. Now, as Prof. Owen has everywhere* described the Saurornia as having procœlian vertebræ, I will state what may be seen in *Dimorphodon*. The anterior end of a vertebra is distinguished by the facets of the zygapophyses looking *upward* or *inward*, while the posterior zygapophyses look *downward* or *outward*.

The vertebra marked *b'* is, from its neural arch, clearly a dorsal. It shows the articular surface of the centrum, which is concave, though not deeply cupped; and the zygapophyses look downward. It is therefore *concave behind*. The dorsal vertebra at *d* is also concave behind. In the vertebra marked *a'*, which in proportions is like a dorsal, though it is in juxtaposition with some of the elongated caudals, the articular surface is concave, and the zygapophyses look up; therefore it is *concave in front*. The vertebra at *b* has a rounded centrum and the length of a dorsal, and is clearly *concave at both ends*. Thus the dorsal

* Brit. Assoc. 1859; Phil. Trans. 1859; Palæontographiæ, 1859-60; Palæontology, 1862, &c.

vertebræ of *Dimorphodon* are not procœlian, but certainly cupped behind, and probably biconcave.

The vertebræ at K Dr. Buckland called the *tail*. The centra are traversed by two basal ridges and a ridge on each side below the neural arch. They want the elevated neural spines which might be expected in cervicals, nor have they the length or the large size common in cervicals of *Pterodactylus*, though *Rhamphorhynchus Gemmingi* has cervicals with similar depressed neural arches, and *P. brevirostris* has cervical vertebræ with centra relatively nearly as short. They are associated with the proximal end of the femur and the os innominatum. The depressed neural arches with elongated zygapophyses are like the hinder caudal of *Cyclodus*. But these are unlike any caudal vertebræ. Besides, the caudals have been described, as have the dorsals. Therefore these bones are either cervical or sacral. Long-necked animals like Chelonians and Birds have similar cervical vertebræ. The ridges remind one of the ridges on the neck-vertebræ of the Goosander and the Duck, and still more of those in the cervicals of wading-birds like the Heron, which also has four ridges, and nearly resembles *Dimorphodon* in the form of the neural arches. Therefore, as the bones are unlike any sacral vertebræ known to me, they are regarded as probably cervical. Each of them is clearly seen to have cup-and-ball articulations. The cup is *behind*, and the ball in *front*.

The scapular arch has been well described by Professors Huxley and Owen.

The mass marked 18, and called the sternum, is very much crushed, and I can give no account of it. The fore-arm is noticed thus:—"2. Fore-arm; showing no trace of ulna." I find ulna and radius both there: they are together, and united throughout their length, but easily traced by a deep groove. At the distal end there is a singular little splint bone attached; and, passing over the first carpal, there are similar bones in the *P. suevicus*. The distal end of the humerus appears to have three condyles.

Prof. Buckland has "four carpals," marked *f, g, h, i*. The first three are clearly carpals; but *i* is merely the distal end of the wing-metacarpal, which is overlaid by 3'', a bone called the "wing-finger metacarpal." This is another important error; for it caused the Doctor to overlook an important generic character. The bone in question is the proximal phalange. And hence the plate shows that there were in the wing-finger at least four phalanges, and not three as represented in the restoration. In the second specimen in the British Museum, where the bones are more *in situ*, Prof. Owen has recognized the wing-metacarpal, which is no longer than the other metacarpals, but

without remarking that, if he and Buckland were both right, their specimens must belong to different genera.

Fibula. It is remarked that "the left tibia is compressed so as to give a false appearance of a fibula." It, however, seems clear to me that the fibula is ankylosed at its proximal end with the tibia (*o'*), that after half an inch it becomes free, and continues so for more than an inch, when it again becomes ankylosed, and gradually thins away. The fibula is a slender bone, and exactly corresponds with the fibula in birds.

As we are indebted to the untiring industry of Prof. Owen for nearly all that has been written on Cretaceous Pterodactyles, it would be impossible to pass over labours which have tended so greatly to illustrate the osteology of these animals. I will therefore add a few elucidatory notes.

In a memoir in the 'Transactions of the Royal Society' for 1859, p. 162, Prof. Owen says, "From observations made on species of Pterosauria, extending from the period of the Lias (as exemplified by *Dimorphodon macronyx*) to the Upper Greensand (as exemplified by *Pterodactylus Sedgwickii* and *P. Fittoni*), I am now able to state that, with respect to the cervical and dorso-lumbar vertebræ, the terminal articular surfaces of the vertebral bodies are simply concave anteriorly, convex posteriorly, and that they consequently manifest the earliest instance of the proœlian type." And again, at the close of the memoir, it is asserted that the cervical vertebræ of *Dimorphodon* present the same type of structure (p. 168) as those from the Upper Greensand. If my determination by the zygapophyses is correct, this is certainly erroneous; for in *Dimorphodon* the cervicals are opisthocœlian, while the dorsals are clearly concave behind, and appear to be biconcave. In the 'Manual of Palæontology,' p. 273, 2nd edition, it is asserted that there is no evidence of *Dimorphodon macronyx* having had a long tail. But, as I have shown that the tail of this genus is like that of the Rhamphosauria, it is evident that Prof. Owen has not recognized either the tail or the neck*. And, on the authority of this assumption that the vertebral characters of the Greensand Pterodactyles were constant throughout the class†, the following note is added to the paper in the 'Phil. Trans.':—"Von Meyer was led to believe, from the crushed *P. Gemmingi*, that both articular surfaces of the bodies of cervicals were concave, and that the hinder surface of a dorsal was not convex; but the error was due to the state of the specimen." I fail to find any evidence of error.

It is always stated (as, for instance, in the 'Palæontology,'

* See 1st Supplement to Cret. Rep. p. 7; and Brit. Assoc. Rep. 1858.

† See 'Palæontology,' p. 270.

p. 272) that the hind limbs bespeak a creature unable to stand or walk like a bird. Pterodactyles certainly stood differently from most birds; for the metatarsals appear to have been placed on the ground, as in the Penguin; but in the figure of *Dimorphodon** the hind limbs will be seen to be quite as long, and nearly as stout, as the fore limbs, while the acetabulum for the femur in the compact pelvis is much larger than the corresponding cavity in the scapular arch for the humerus.

In Prof. Owen's paper on the supposed bird-bones from the Wealden (Quart. Journ. Geol. Soc. p. 100) it is stated that Pterodactyle bones were filled with a light fluid marrow. And in the 'Palæontographical Monograph' (1851) is a statement repeated in the 'Palæontology' (p. 272), that the Pterodactyles had leathern wings. I have failed to find any anatomical evidence for these statements.

In Dixon's 'Geology of Sussex' (1850) the Reptiles and Pterodactyles were described by Prof. Owen. Fig. 2, pl. 39, appears to me to be the first phalange. Fig. 12, in the same plate, is the distal end of the metacarpal of a wing-finger.

In the Palæontographical Society's Monograph for 1851, pl. 30, figs. 1, 2, 3 represent a magnificent Pterosaurian bone in the collection of Toulmin Smith, Esq. Prof. Owen says, "It is either one of the bones of the fore-arm, or more probably the first or second phalange of the wing-finger."

The reasoning by which I determine the fossil is this:—It has two unequal, concave articular facets; these evidently have worked on convex condyles. Between the facets is a large central concavity, which indicates a corresponding central convexity behind the condyles in the corresponding bone. Therefore, as the distal end of the humerus is the only surface which presents these characters, the fossil is evidently an *ulna*.

Pl. 30. fig. 5. The supposed ulna and radius need examination.

Pl. 24. fig. 1 is described as lower half of humerus, with part of ulna or radius. There is no humerus here: the bones are ulna and radius.

Pl. 24. fig. 2 is a first phalange; pl. 32. fig. 2 is the same. Pl. 24. fig. 3 is (?) the proximal end of a wing-metacarpal. Pl. 32. fig. 3 is a portion of the proximal end of a wing-metacarpal, and not a femur. Pl. 32. figs. 6 & 7 is described as the proximal end of a humerus; but it appears to me to be the distal end of an ulna.

Pl. 32. figs. 4 & 5 is a wing-metacarpal.

Any remarks in detail on Cambridge specimens will find their place in my monograph of these animals.

To Prof. Owen's second monograph (1859) I have only to

* Trans. Geol. Soc. ser. 2. vol. iii. p. 27.

add that the (?)frontal in pl. 4. figs. 6, 7, 8 is not a frontal, but a bone from the base of the skull—seemingly the vomer. Pl. 4. figs. 1, 2, 3, called “a long bone of the wing,” is the distal end of a humerus. Pl. 4, figs. 4 & 5, is certainly not a “wing-metacarpal,” and is unlike any bone I know.

In the third monograph (p. 6) the basi-occipital is described and figured upside down, the outside of the skull being regarded as the neural surface. But the only other error of determination is that the bone regarded as a middle caudal of a *Pterodactyle* (pl. 2. figs. 15, 16) is no part of a *Pterodactyle*.

BIBLIOGRAPHICAL NOTICE.

Longicornia Malayana; or, *a Descriptive Catalogue of the Species of the three Longicorn Families Lamiidæ, Cerambycidæ, and Prionidæ collected by Mr. A. R. Wallace in the Malay Archipelago.*

By FRANCIS P. PASCOE, F.L.S., Pres. Ent. Soc. Lond. (Part 1.) MR. PASCOE, the President of the Entomological Society of London, having obtained the large collection of Longicorn Beetles formed by Mr. Wallace during his travels in the Eastern Archipelago, has undertaken the task of preparing a complete descriptive catalogue of these interesting insects. Some conception of the magnitude of the undertaking may be formed from the fact that Mr. Pascoe estimates the total number of species in the collection at “something less than a thousand,” and of these more than eight hundred are believed to be still undescribed. With such an important contribution to entomological literature in their hands, the authorities of the Society have wisely determined to devote a whole volume of their ‘Transactions’ to its reception; and we have before us the first part of this volume, the third of their third series of ‘Transactions.’ We may add that it is illustrated with four beautiful plates, the cost of which, as Mr. Pascoe informs us, is partly defrayed by Mr. W. Wilson Saunders.

With regard to the classification of the Longicornia, Mr. Pascoe seems to be rather dissatisfied with the complicated groupings in vogue with many entomologists, and he reverts to the simpler system of Leconte, in which the whole tribe or “suborder” is divided into the three families, *Lamiidæ*, *Cerambycidæ*, and *Prionidæ*. As subordinate to these he admits a great number of subfamilies; but he holds that, for all practical purposes, these *named* divisions are sufficient, and that any other sections that may be found necessary should be indicated simply by numbers.

The general inspection of the collection of Malayan Longicorns leads Mr. Pascoe to dissent from the somewhat sweeping assertion of Mr. Wallace, that, with respect to every branch of zoology, the western islands of the Malayan archipelago belong to the Indian, and the eastern to the Australian region. He gives a table of ten of the largest genera in Mr. Wallace’s collection, including 517

species; of these only six are represented in Australia, and by only sixteen species. He adds that he has not been "struck by any special differences between the western and eastern portions of the archipelago, so far as the Longicornia are concerned;" and says further, "With regard to the Coleoptera generally, my impression is that there is a fair admixture of forms from Singapore to New Guinea, without any remarkable division between them anywhere; but that between the Australian and Malayan regions (including New Guinea) the difference, on the contrary, is really something marvellous." The weight to be attached to these observations will be more definitely ascertained when Mr. Pascoe has completed his descriptions of the species. Under any circumstances, his work will prove a valuable contribution to entomological literature.

MISCELLANEOUS.

Note on Dr. Fitzinger's Paper on Ptychochœrus plicifrons.

By Dr. J. E. GRAY, F.R.S. &c.

I AM amused at Dr. Fitzinger's observation (*Annals, ante*, p. 80) that this Pig "has been imperfectly noticed by Bartlett and Gray." Mr. Bartlett gave a figure and an account of the external appearance and habits of the animal; and in my paper I not only described its external characters, but likewise described and figured the skull, and pointed out how it differs from that of other Pigs.

But my chief object in this note is to restate that there can be no doubt that the Pig I described came from Japan. The ship that brought it came direct from that island, and was never near Abyssinia. Also to express my astonishment that Dr. Fitzinger should try to identify it with the "Hassama" of the Abyssinians because that "animal is black, has a short blunt head and large ears"—a description that will fit several domestic breeds of the common Pig. If the "Hassama" had such a plaited face as the Japan Pig, it would not have escaped Dr. T. Von Heuglin's observation. From the description, I suspect that the animal described by Dr. Fitzinger is only one of the half-breeds bred between the typical *Centuriosus pliciceps* and a common domestic sow of the Berkshire breed, several of which were sent by a dealer to the Continent.

Note on the so-called "Japanese" Pig (Centuriosus pliciceps, Gray; Ptychochœrus plicifrons, Fitzinger). By P. L. SCLATER, M.A., F.R.D., F.R.S.

In the last number of the 'Annals,' I observed a notice of a paper by Dr. L. J. Fitzinger in the 'Sitzungsberichte' of the Academy of Vienna, in which it is stated to be Dr. Fitzinger's opinion that Abyssinia, and not Japan, is the native country of this curious animal. In confirmation of this view, Dr. Fitzinger thinks it probable that the new Pig recently discovered by Heuglin in Abyssinia, and called *Hassana*, may be the same as the so-called "Japanese" Pig.

While I agree with Dr. Fitzinger that the name of "Japanese," as applied to this Pig, is in all probability a misnomer, I believe he is quite mistaken in supposing that it has anything to do with Abyssinia, for the following reasons:—

1. As far as I have been able to ascertain, the first examples of this beast which reached Europe were those received, in 1860, by the Zoological Society of Antwerp. Mr. Jacques Vekemans, the Director of that establishment, informs me that he purchased a pair and three young of this Pig out of an English vessel, which arrived in the port of Antwerp on the 10th of February of that year. The vessel, as Mr. Vekemans believes, came from Shanghai; but the captain stated that he had bought the Pigs in Japan, which was probably the origin of their being called "Japanese Pigs."

Mr. Jamrach, the well-known dealer in living animals, who has had many of these Pigs through his hands, informs me that he believes China, and not Japan, is their true home, several cases having occurred, to his own knowledge, in which they have been imported in vessels coming direct from the former country.

2. The "*Hassana*" of the Abyssinians, recently described by Dr. Th. von Heuglin in the last-published volume of the *Acta Academiæ Leopoldino-Carolinæ**, under the new generic and specific names *Nyctichærus Hassana*, has evidently nothing to do with the so-called Japanese Pig, but, so far as I can judge from his imperfect description, is probably a species of *Potamochærus*, a genus which, as I have shown†, differs from *Sus* in the entire absence of the fourth premolar from each jaw.

I think, therefore, we may safely conclude that the true home of the so-called Japanese Pig is China, where, as we know, such monstrous varieties of domestic species are much appreciated. But, for my own part, I cannot see the slightest reason for regarding the "Japanese" Pig as anything more than a domesticated variety. The differences in the skull, noted by Dr. Gray (*P. Z. S.* 1862, p. 13), are no doubt considerable; but they are not greater than in the case of the Polish Fowl, with its abnormal development of the summit of the cranium, or the Pampas Cow‡, with its stunted nasals. These cases must, in my opinion, be all referred to the same category of exaggerated variation produced by lengthened domestication.

On the Flight of Birds and Insects. By E. LIAIS.

In the flight of birds and insects, there are three cases to be taken into consideration:—1, flight without locomotion; 2, flight with locomotion and beating of the wings; 3, flight without beating of the wings, or gliding flight. This third mode presupposes a previous locomotion, produced by beating of the wings. The ascensional force is then obtained at the expense of the active force of the movement of progression, by an effect of the inclination of the wings.

* Vol. xxx. (1864) Beiträge zur Zoologie Afrika's.

† *P. Z. S.* 1860, p. 301.

‡ Cf. *Cat. Ost. Ser. Mus. R. Coll. of Surgeons*, ii. p. 624. no. 3832.

According to this inclination, the animal may ascend or move horizontally, as long as its rapidity of motion is not too much diminished by the resistance of the air; to descend requires merely a change of the inclination of the wings; to remain at the same elevation, the animal must again have recourse to the beating of the air.

Flight without locomotion is effected by many birds and insects. In this mode of flight, it appears that, in ascending, the wing partially destroys the ascensional effect which it produced in descending. In birds, as the wing presents its convexity in ascending, and its concavity in descending, it cannot produce the same effect in both directions, even with an equal velocity; but this difference does not exist in those Neuropterous and Dipterous insects which hover in one place. The explanation of this fact is to be found in the different velocity with which the animals raise and depress the wings. In the Frigate-birds, the wing descends at least five times as quickly as it rises. The resistance of the air being in the proportion of the square of the velocity of the wing, the ascending or descending velocity of the animal, caused by a movement of the wing, is in proportion to this resistance multiplied by the duration of action, which is in an inverse ratio to the velocity of the wing. The ascending or descending velocities of a bird, caused by the movements of the wings, are therefore to each other as the velocities of the wings in their ascending and descending movements.

Flight with locomotion and beating of the wings is the most frequent kind, and appears to require less labour; for the movements of the wings are much less rapid. The cause of this is, that the wing experiences no resistance in ascending. When a bird is about to depress its wing, this is a little inclined from before backwards. When the descending movement commences, the wing does not descend parallel to itself in a direction from before backwards; but the movement is accompanied by a rotation of several degrees round the anterior edge, so that the wing descends more in front than behind, and the descending movement is transferred more and more backwards, at the same time that the wing becomes more and more inclined, so as to give a movement at once ascending and accelerative of the horizontal motion of the animal. Towards the close of this movement, a fresh rotation takes place round the anterior margin of the wing, but in the opposite direction, so as to bring the posterior part on a level with the anterior, or even a little below it. This also produces an ascending movement. When the wing has completely descended, it is both further back and lower than at the commencement of the movement, but, as at this commencement, its posterior part is a little lower than its anterior. It is then raised in this position.

To analyze what takes place in this process, we must take a point of the anterior margin, and examine its movements, not in relation to the animal, but to the mass of air in the midst of which it moves. In a horizontal direction, this point is displaced to an extent equal to the sum of its horizontal movement in relation to the centre of gravity of the animal, in consequence of the movement of the wing

forwards, plus the movement of the centre of gravity of the bird, which is transported horizontally forward. In the vertical direction, the point in question rises during the elevation of the wing. The resultant of the two movements is a straight or curved trajectory, according to the relation of the movement of the wing forwards and upwards. If the wing rises at first more than it moves forward, and finally moves forward more than it rises, this curved trajectory will present its concavity to the ground. But in all cases, as the horizontal displacement of the centre of gravity of the animal is very great in comparison with the amount to which the wing is elevated, this trajectory is at all points very slightly inclined to the horizon. If the animal keeps the wing inclined to the same extent, the wing, in ascending, will only experience resistance at its edge, seeing that its surface is constantly applied upon the trajectory described by the anterior margin, this trajectory being curved when the wing is curved, as in birds, flat when the wing is flat, as in the Neuroptera.

Moreover, if the animal inclines the wing more than is necessary to apply it upon the trajectory of its anterior margin, an ascending component is produced, during the elevation of the wing, at the expense of the horizontal velocity. In this case the wing during its elevation, far from destroying its descending effect, as is commonly supposed, acts in the same direction as during its descent.

The relation of the weight to the wing-surface increases as the extent of wing. In an Urubu with an extent of wing of 1.37 mètre, the weight supported per square mètre by the whole surface (extended wings and tail and body) was 4.82 kil., or, neglecting the surface of the body and tail, 5.92 kil. In the Humming-Bird the weight supported, referred in the same way to the square mètre of total surface, is only 1.05 kil. In normal flight the velocity of the Urubu, determined by that of its shadow on the ground in calm weather, varies between 10 and 12 mètres per second. Lastly, from the direct measurement of the resistance of the wings in a beat of the same duration, and from the number of beats made in a given time during horizontal flight, it appears that the amount of work produced by birds of the size of the Urubu per second does not equal in amount that necessary to raise one-third of the weight of the animal 1 mètre.

The movement of the wings is an accelerated movement. Experiments have long since shown that the resistance to this kind of movement is greater than that to a uniform movement. This is due to the circumstance that, in the former case, a certain mass of air which accompanies the body has to be set in motion. If the accelerative force be very great, and the movement be annulled before the final velocity has acquired a great value, as is the case in birds, the term of the resistance depending upon the accelerative force is very great in proportion to the term depending only upon the squares of the velocities, which alone is manifested in uniform movements. In the flight of birds, the phenomenon of reaction is therefore of more importance than the other phenomena of resistance. Driving downwards a certain volume of air, the body of the bird rises by

recoil, like a rocket. From this it is easy to see that, in the mechanical imitation of flight, it would be advantageous to reduce the size of the beats, and to increase their frequency.—*Comptes Rendus*, Nov. 28, 1864, p. 907.

On the Fumariæ with irregular Flowers, and on the Cause of their Irregularity. By D. A. GODRON.

When the flowers of the Fumariæ are examined in their first stage of development, they are all perfectly regular, but flattened before and behind, as if they were compressed between the axis of the inflorescence and the bract that envelopes them. They retain this regularity in the genera *Dielytra*, *Adlumia*, and *Dactylicapnos*. In these three genera, the external or lateral petals undergo an important modification in the course of their development: the base of each of them is produced into a short, rounded spur, and these two nectariferous appendages are perfectly symmetrical. Why, then, in *Fumaria*, *Corydalis*, &c. (which have originally the same organization) is only a single spur developed, whilst the other spur is aborted, together with its nectary, in such a manner that the flower becomes very irregular, and this irregularity is of a special nature? Moreover the single spur which makes its appearance becomes extraordinarily developed, if we compare it with the two spurs of the Fumariæ with regular flowers, and especially the spurs of the flowers of *Corydalis*, which will be referred to hereafter.

To what is the abortion of one spur due? To discover the cause of this, I have observed the flowers of Fumariæ at different stages of development, and especially those of our indigenous species of *Corydalis*, which, from their size, are particularly favourable for observation. I have dug up specimens of *Corydalis solida* and *C. cava* before the stem has issued from the ground in January, and then in February and March. I have ascertained that the flowers are closely pressed against each other, and that even at the first of these periods the single spur is already apparent. If, then, we examine from above the bunch of flowers previously denuded of its bracts, we find that the spurless side of each flower is supported obliquely upon the posterior surface of an older flower. I may add that the two lower flowers are supported upon the base of two stem-leaves, which enter into the regular series of the floral spire. The same facts are observed in *Fumaria*.

From this arrangement, it appears that all the flowers are compressed at the base of one of their sides, which prevents the development of the nectary and of its sheath or spur; on the opposite side, on the contrary, the spur is not hindered in its evolution, and grows without any obstacle. It is to this circumstance, apparently, that we must attribute the abortion of one spur with its nectary, and, consequently, the irregularity of the flowers, in many genera of the family Fumariæ.

But why is not this irregularity of the flowers produced in *Dielytra* and *Adlumia*, as well as in *Corydalis* and *Fumaria*? The arrange-

ment of the raceme in the Fumariæ with regular flowers furnishes us with no explanation of this circumstance, although it is different. But I have ascertained that the development of the spurs commences late in these plants, when the elongation of the raceme has separated the flowers from each other; no lateral compression is then possible, and the two spurs are freely developed, perfectly equal, and regularly symmetrical.

Lastly, in support of these views, I may add an observation which appears to be still more demonstrative. The primitive, regular form of the flowers of Fumariæ, which subsequently become irregular, is sometimes persistent. In the arboretum of the Botanic Gardens at Nancy I have for three years observed eighteen plants of *Corydalis solida* with all the flowers peloriate; these have hitherto proved completely barren, although the pollen appears to be normal, and abundantly impregnates the two lips of the stigma.

These peloriate flowers are erect and a little spread out; in form, size, and coloration they resemble those of *Dielytra formosa*; so that this anomaly represents the normal type of a genus of the same family. The sepals are small and regular. The corolla presents two perfectly equal lateral spurs, which are conical, obtuse, slightly divergent, and 2 millim. in length—that is to say, much shorter than the single spur of the irregular flower of the same species; the nectaries are equal, short, and bent into a hook. The two outer petals, which bear them, are symmetrical; and this is also the case with the internal petals. The two bundles of stamina are arranged normally. The flowers persist for a longer period than in the type, as is also the case in sterile hybrids.

To what is this return to the regular type due? In order to investigate its causes, I dug up, on the 10th February, 1864, two specimens of these plants which were still buried in the soil, and compared them with other individuals of the same species, but with irregular flowers. The latter already presented their single spur pretty well developed; the peloriate flowers, on the contrary, presented no trace of a spur. On other plants, I have followed the gradual development of the flowers; and it was only on the 16th March, when the stem had issued from the earth, the raceme had become free from its spathiform envelope, and the perfectly free flowers could no longer undergo any compression, that the spurs began to be developed. Thus, in this peloriate flower, the same things take place as in the genera of Fumariæ with normally regular flowers.

Hence it appears to be evident that the lateral compression of the base of one of the margins of the flower at the moment of the development of the nectaries must be the cause of the abortion of one of those organs, and of the spur in which it is enclosed; from this arises the irregularity of the flower.—*Comptes Rendus*, December 19, 1864, p. 1039.

Note on Sternotherus Adansonii from West Africa.

By DR. J. E. GRAY, F.R.S., &c.

On the 26th of May last year I read a paper before this Society

on the species of *Sternothæri* then in the British Museum, and I divided them into sections or subgenera. In that paper I took no notice of *Sternothærus Adansonii*, as that species was only described from a shell in the Paris Museum, said to have come from the Cape de Verd Islands, which had been noticed by Schweigger under the name of *Emys Adansonii*.

We have just received, through Mr. Dalton, two specimens of a species of the genus from the west coast of Africa, which is very distinct from any of the others, and, I have little doubt, is identical with the shell in the Paris Museum. As it is in a perfect state and well preserved, I think it well to give a new description of it.

It belongs to the subgenus *Notoa*, the head being short, and the temples covered with a large triangular space of small polygonal shields.

The hinder part of the sternum of the animal is narrower, and more like that of the genus *Pelomedusa* than any of the other species of the genus *Sternothærus*; but the front lobe is distinctly moveable, and united by a straight suture.

STERNOTHÆRUS ADANSONII.

Shell oblong ovate, depressed, rather wider behind than in front; dark olive, with very close, regular, uniform radiating black lines, sometimes broken up into small dark spots; sternum and undersides of the margin yellow; the areola of the sternal plate square, blackish.

The head depressed, with very close, nearly uniform, unequal black lines; the frontal plate very large, with a triangular patch of small scales on the temple, reaching to over the front edge of the ears; the lips white; the throat pale; the feet olive above, pale beneath; claws $5/5$, olive, with a yellow streak in the middle of the upper surface.

The first vertebral plate much longer than wide, narrow behind, with a blunt keel ending in a rounded tubercle behind. The second, third, and fourth vertebræ about as wide as long, with a sharp keel, ending in an acute tubercle near the hinder edge of each shield; the fifth vertebra like the first, but only very slightly keeled. The front marginal plate wide, those over the hinder legs rather wider, and those on the sides of the shell very narrow. The gular plate small, triangular; the intergular one lozenge-shaped, narrowed in front; the pectoral plates narrowed and truncated at the inner edges.

Hab. West coast of Africa (*Dalton*).

The species of this genus seem to have a confined range. Thus there are two species of the first subgenus (*Tanoa*)—one from S. Africa and Natal, and the other from Western Africa; in the same manner there are two species of the second subgenus (*Notoa*)—one from Madagascar and the other from the West African coast. Thus,

1. *Tanoa*.

2. *Notoa*.

S. sinuatus S. and E. Africa *S. subniger*.
S. Derbianus West Africa *S. Adansonii*.

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XVIII.—*Conjugations of* Navicula serians, N. rhomboides, and Pinnularia gibba. By H. J. CARTER, F.R.S. &c.

[Plate IV.]

It is now just nine years ago (viz. in January 1856) that my descriptions of three species of Diatomeæ in conjugation respectively were published in the 'Annals'; and since that time so little has been done in the subject that hardly more than a dozen instances appear to have been added; at least the late and lamented Prof. Smith, in his 'Synopsis' (I quote from the excellent article on the Diatomeæ in Pritchard's last edition of his 'Infusoria' for all references of this kind), enumerates but thirty-two species; and twenty had been observed (my own included) when I made the communication from Bombay in the 'Annals' to which I have alluded; while among all these conjugations there appears only one instance in a Navicular form, viz. that found by Dr. Griffith in 1855, and published by him in the 'Annals' a few months before my own paper. This presented such a remarkable feature in addition to what had already been shown, viz. the presence of a transversely ringed siliceous sheath enclosing the sporangial frustule, that it has ever since been desirable to determine if instances of it in other Navicular forms might indicate its usual occurrence among them also, or its extension to the conjugation of the Diatomeæ more generally.

Anxious to satisfy myself on this point, I have often, since the publication of Dr. Griffith's interesting discovery, sought for a conjugation of the kind; and although I have frequently met with isolated instances of conjugation in *Gomphonema*, *Cyclotella*, and *Melosira* in Bombay, as well as latterly in Devonshire, it was not until the beginning of the month of July last (1864) that I happened to fall in with a number of Diatomeæ among

which three bog-species, viz. *Navicula seriens*, *N. rhomboides*, and *Pinnularia gibba* appeared in different stages of conjugation, each presenting the ribbed sheath above mentioned. They were enveloped in a gelatinous substance which is so common and so remarkable in the heath-bogs about the neighbourhood of Budleigh Salterton, that it seems worthy of a short description.

This jelly-like mass, which is colourless or whitish so long as it is not permeated by green Algæ, covers the surface of the water in the depressions of the bogs, in a sheet-like form, about half an inch or more in thickness, fragile and of a granular consistence, while the number of living and dead frustules of Diatomæ in it, frequently to the almost total exclusion of all other organisms, seems to indicate that for the most part, if not entirely, it is produced by the Diatomæ themselves.

Be this as it may, it was in a portion of such jelly (where I had expected to find them, and where I hope to find more), reposing on gravel through which a spring was oozing, that I observed the three species mentioned in profuse conjugation respectively, and in all stages; but as *Navicula seriens* afforded the best typical examples, I shall, in accordance with my delineations, describe it first and most particularly.

Before entering upon the description, however, I would premise that all the figures in the plate, with most of their detail, are drawn upon the scale of $\frac{1}{1\frac{1}{2}}$ th to $\frac{1}{6000}$ th of an inch, and the arrangement of their elements just as they appeared under the microscope, with the exception only of fig. 1. (Pl. IV.), in which the spore-cell (*c*) was not visible, and the conjugating frustules were so much separated from their contents by the necessary pressure of the covering-slide on the jelly in which they were imbedded, to bring them into focus, that, to replace the former and to restore the latter to a position in which they might be seen, the whole has been delineated as represented in the figure. Hence some little doubt exists in my mind as to whether the process commences with one, or directly in two spore-cells (as in fig. 2); but for the present I shall describe it as commencing with the former.

Thus the reader will be able to obtain a just idea of the relative size and position of the different conjugations and their elementary parts, as well as their actual dimensions by measurement. The dark shade represents the endochrome, and the circles the oil-globules, characteristic of the confused mass which the whole forms when forced into the spore.

It is true that these elements are more or less distorted by the pressure to which I have alluded; but this is more than counter-balanced by their being so far kept together by the jelly in which they are imbedded, that the observer neither loses any of

them, nor experiences any difficulty in restoring them to an intelligible position, while, where such conjugations occur without this nidus (as on freshwater plants, &c.), they are likely, especially in their advanced state, to fail in presenting some of their more deciduous parts. It is perhaps on this account that the ribbed sheath of the sporangial frustule has not been more frequently observed; and as its presence, with other points heretofore unnoticed, renders a special description desirable, I shall give the typical one of *Navicula serians* as follows:—

Navicula serians, Kg. (Smith, Synopsis, pl. 16. fig. 130). Pl. IV. fig. 9, enclosed in its sheath. Longest diameters 24 by 4 6000ths of an inch.

Conjugation.—1. Two frustules, varying a little more or less in size, approximate themselves (Pl. IV. fig. 1). 2. They secrete a gelatinous substance around them, which becomes covered by a delicate pellicular membrane, *a a*. 3. The sarcodal sacs force open respectively their frustules through the fissiparating divisional line, and carrying with them their contents, now all undistinguishably mixed together, approach each other and unite into one (?) spherical mass, called the spore or sporangium, *c*. 4. The sporangium divides itself equally into two spherical sporangial cells, each of which forms around itself a thick opalescent capsule (fig. 2 *f, f*). 5. The capsules respectively divide in their equatorial lines, and expose the sheaths of the sporangial frustules (fig. 3 *g, g*). 6. The sheaths become elongated, and at the same time present thread-like rings on their surface, diminishing gradually in thickness towards each extremity, but in close approximation throughout, except at the middle, where there is an interval of $\frac{1}{8000}$ th of an inch between them, or equal to three times the breadth of the neighbouring rings (figs. 4, 6, 7 *h, i*). 7. The sheaths, elongating, carry out the ends of the capsules upon their extremities (figs. 3–8 *f*). 8. The hemispheres of the capsules disintegrate into short, fusiform, curved, thread-like filaments (fig. 8 *f*). 9. The sheath is fully formed, and the sporangial frustule appears within it (fig. 9). 10. The empty sheath presents a longitudinal dehiscent fissure, through which the sporangial frustule obtains its exit (fig. 10).

Having only observed one instance in which the longitudinal fissure of the sheath was present, I am not quite certain that the frustule always obtains its exit through this kind of dehiscence; nor am I certain that the frustule always comes forth singly, having often seen it in duplication within the sheath, by which operation it might be the better able to force open the latter.

Neither the endochrome nor the nucleus appears to be completely reformed and defined until the frustule has undergone one or two duplicative divisions.

Precisely the same number of coverings accompanies the sporing of *Spirogyra*, and especially of *Staurocarpus*, where the spore is formed between the two conjugating cells, as in that of *Navicula serians*, viz.:—(1) the old cells of the filament, which correspond to the frustules; (2) the newly secreted part of *Spirogyra* or cell of *Staurocarpus*, into which the contents of both the parent cells are poured confusedly, corresponding to the gelatinous envelope; (3) the thick brown capsule formed round the latter, which answers to the capsule of the spore of *Diatomeæ*; (4) a thin transparent cell within this, which is analogous to the sheath of the sporangial frustule; (5) and, lastly, the young *Spirogyra* itself, which is homologous with the sporangial frustule, and which, on germinating, bursts forth with the bands of chlorophyll of the species nearly all restored to their proper form and position. But there is this difference, viz. that the spore of *Spirogyra*, &c., rests from its labours for a certain time before the young sporangial plant comes forth, while that of the *Diatomeæ* continues its progress throughout the process uninterruptedly, until the sporangial frustules are eliminated in full activity.

The effect of the conjugation, then, in *Navicula serians* is to produce two sporangial frustules nearly twice as large as the two conjugating ones—an increase in size which may be inferred to owe its origin to the contents of each of the conjugating frustules having become sufficient in quantity for duplicative division just before they entered into conjugation, whereby they would produce two sporangial frustules nearly twice as large as their ordinary size.

Sometimes the process may be wholly abortive, from accidental circumstances; at others it may be only partially so, and thus produce only one sporangium capable of developing a frustule, while the other remains sterile for want of sufficient material to work upon, as in Pl. IV. figs. 4 & 15.

The average largest size of *Navicula serians* present with the conjugations was that of fig. 9, of which the measurement is above given, and that of the sheath within which it is enclosed a little larger.

When these conjugations are slightly boiled in nitric acid, the sheaths remain entire, as stated by Dr. Griffith; but after prolonged boiling, I could not recognize any trace of them. Possibly they may have escaped my observation, as the same naturalist has stated (*apud* Pritchard) that those of *Navicula amphirhynchus* resisted the action of a “red heat” as well.

Navicula rhomboides, Ehr. (Smith, Synopsis, pl. 16. fig. 129). Pl. IV. fig. 13. Longest diameters 22 by 5 6000ths of an inch.

The figure of this frustule, which has a shade over its surface like ground glass, as it appears under a magnifying power of 800 diameters, admits of having this shade resolved into transverse lines by a higher power (see Smith's figure). Two conjugations only of it are given, although several more were sketched, and still many more examined; but to these are added two other conjugations (figs. 14 & 15), of smaller individuals of the same species, whose specific characters, although identified by myself, cannot be represented upon the scale on which they have been drawn for publication, on account of their extreme minuteness on the smaller frustule.

These conjugations, it will be observed, produced sporangial frustules of the size of fig. 16, which, in its turn, will be observed to be about the size of the conjugating frustules in figs. 11 and 12, from which a frustule about the size of fig. 13 would be produced; while I subsequently found a group where the *conjugating* frustules were nearly as large as the latter, and which therefore would have produced a frustule still larger than fig. 13. The conjugating frustules of these three groups, beginning with the smallest, which was $\frac{1}{1500}$ th of an inch long, gave approximately the proportions of 4, 11, and 17; while those of the sporangial frustules which they respectively produced afforded the proportions of 10, 18, and 26. Thus we are presented with four successively larger sizes of the same species, three of which were produced by conjugation, while these are only to be considered average measurements of the elements of the conjugations witnessed, there being every variety of size both of conjugating and sporangial frustules between them.

Another observation made on the smallest of the conjugations was that which may be partially seen in fig. 14, viz. that the empty valves of the conjugating frustules appeared to be borne out upon the ends of the sheaths, instead of lying parallel to them as in the other conjugations. Whether this imports that it may be the case in the conjugation of small frustules generally, and not with large ones, is a question that I am not prepared to answer.

Pinnularia gibba, Ehr. (Smith, Synopsis, pl. 19. fig. 180). Pl. IV. fig. 21. Longest diameters 22 by 2 6000ths of an inch.

Two conjugations only of this species are delineated, viz. figs. 17 and 18. In the latter the valves of one of the conjugating frustules had been rubbed off, while the sheath in fig. 20 and the conjugating frustule in fig. 19, which was in company

with it, were the largest conjugating elements observed. Frustules, apparently of the same species, further down the stream were more than half as large again as the largest size found with the conjugations, which is that above given (fig. 21).

Thus we observe that all these conjugations are of that class in which two conjugating frustules produce two sporangial ones; moreover that, with the exception of the small conjugating frustules of *N. rhomboides*, which are terminal, the latter have their conjugating frustules arranged laterally, and not terminally. Lastly, we observe that the sporangial capsules are not retained on the ends of any of the sheaths but those of *N. serians*. Perhaps this may have arisen from their having been thinner, and therefore more fugaceous; or, from want of more extended observation on the less developed groups, I might not have observed them.

Such a capsular covering, however, I suspect to be common to all the spores of the Diatomeæ; and I have also no doubt that, in some of the conjugations already described, the ribbed sheath has been overlooked. It seems to me, now, that I can detect it in my published figures of the conjugations of *Cymbella pediculus*; and I am sure also, by my drawings, that it was present in some conjugations of *Gomphonema* which I also found near Budleigh-Salterton in April 1863. But, as I have before stated, these elements are much better recognized among a large number of conjugations which are imbedded in the transparent jelly mentioned than in the naked and occasional occurrence of them under other and less favourable circumstances.

Formerly I expressed the opinion (*Annals*, *l. c.*) that the object of conjugation in the Diatomeæ was to restore the normal size of the frustule, which had been reduced by repeated duplicative division; also that one conjugating frustule was always smaller than the other,—citing A. Braun and Meneghini as authorities for the former, and assigning my own reasons for the latter.

With reference to A. Braun's opinion that the frustules of the Diatomeæ should decrease in size by duplicative division because it is the case with the cells of *Glæocapsa*, &c., I now think that, until this has actually been seen among the Diatomeæ, the smallness, and therefore variety in the size, of their frustules should not be thus explained.

Again, the statement of Meneghini, that, in *Cocconeis*, the effect of duplicative division taking place horizontally through this conico-truncate frustule should reduce the size of the frustule formed from the smaller end, I also do not now think should be received as an instance of the reduction in size of the Diatomean frustule by division, until it has in like manner been

established by actual observation, since it seems just as natural to me that the smaller or conical part should supply itself with a larger portion for a base, and that the larger or basal part should supply itself with a smaller portion for its cone, as that the hemispheres of a divided spherical cell of *Melosira* should make up their deficiencies as they do respectively without undergoing the least diminution in their new halves; if anything, I think now that the frustules should increase in size, as Ralfs's figure of *Fragilaria virescens* (Annals, 1843, vol. xii. pl. 2. fig. 6 a) would appear to show.

My view, that one of the frustules in conjugation was always smaller than the other as a matter of course, and not an accidental occurrence, should also undergo modification, and has therefore been rightly opposed by the late Prof. Smith; but, although this excellent diatomist has stated that it is altogether "irreconcilable" with the conjugation of the stalked varieties, where it takes place between the halves of the frustule which has just undergone division, and a matter of chance rather than one "of course" among the other tribes, still the entire separation of the halves of the free frustule on duplicative division makes the chances of their coming together again for conjugation so very remote that it can rarely occur. Hence, although with the conjugations of the free Diatomeæ it does not follow as a "matter of course" that one frustule should be smaller than the other, it will be inferred, from what has been above stated respecting the great diversity of size which must exist among individuals of the same species, that with them there is very little likelihood of two of exactly the same length meeting again for this purpose; so that it probably seldom happens that there is not some disproportion between them, although this does not generally amount to very much, and is not a necessary part of the process, as I had formerly supposed when I thought the object of conjugation might be chiefly to restore the size of the frustule, already diminished by repeated duplicative division, rather than (as I now think, and shall presently state that it is chiefly) to raise it to a size fit for impregnative generation.

As regards the diversity of size generally among individuals of the same species of Diatomeæ, it now seems to me that we must seek for the explanation of this chiefly, if not entirely, in the different sizes of the conjugations, together with the varying sizes of the conjugating frustules themselves, commencing from the embryonal frustules upwards, until the maximum size of the species is attained, or, to use other words, in the amount of protoplasm, &c., furnished by these frustules; and therefore that this conjugating, however much it may be a modification, is not the process of impregnative generation in the Diatomeæ,

but the preliminary steps to the formation of a larger individual, in which the process, still unknown to us, finally takes place. Nor do I see how it can be a modification of the true impregnative process, as in the former instance large quantities of protoplasm, &c., are brought together to produce larger frustules, and in the latter it is *smaller* quantities to produce them.

Indeed Prof. Smith observes that "the ordinary Diatomaceous frustule seems to owe its production to the protoplasmic contents of the sporangial frustule formed by the process of conjugation," and that subsequently, under favourable circumstances, its siliceous epiderm opens "to permit the escape of the contained endochrome, which is resolved into a myriad of embryonic frustules; these either remain free or surround themselves with mucus, forming a pellicle or stratum, and in a definite but unascertained period reach the mature form of the ordinary frustule." After which he adds that "the size of the mature frustule before self-division commences is, however, dependent upon the idiosyncrasy of the embryo, or upon the circumstances in which its embryonic growth takes place; consequently a very conspicuous diversity in their relative magnitudes may be usually noticed in any large aggregation of individuals, or in the same species collected in different localities." Thus Prof. Smith believed that a diversity in size might commence even in the embryonal development, which, it seems to me, though more or less perpetuated throughout, might still be equalized to a certain degree by the conjugation of a larger with a smaller frustule. However the latter may be, Kützing surmised, and Rabenhorst affirmed, a similar mode of reproduction in the Diatomæ to that described by Prof. Smith (Pritchard, p. 74).

That the frustule is raised by repeated conjugation to its maximum or required bulk may be inferred from what I have figured and stated, respecting the various sizes of the conjugations and their elements, of *Navicula rhomboides*; but in what the process of impregnative generation consists remains for future observation to determine, and is therefore a question on which we can only speculate now by the aid of analogy.

For this purpose, then, let us begin by enumerating the full complement of elementary parts which make up a Diatom. They are as follows:—(1) the siliceous frustule; (2) the sarcodal sac within it, containing (3) the nucleus; (4) the endochrome, (5) the "glair-cell," double, one towards each end; (6) refractive cells, not spherical; (7) starch-grains; (8) molecular granules. The presence of Nos. 6, 7, and 8 is variable; and there may, of course, be more organs than have yet been recognized.

I have not added a layer of sarcode externally, because its presence there may or may not be continuous in duration or

extent, as it is probably composed of a coalescence of pseudopodia extruded, through apertures of the frustule, from the sarcode internally, to meet the requirements of the organism; but its existence may be inferred from an attentive observation for a few moments of a living active Diatom, when the following phenomena may be witnessed:—(1) the power of attaching to itself, retaining, and casting off a particle of foreign matter, which particle may be transported over its surface, hither and thither, backwards and forwards, from one end of the frustule to the other, retarded in its course, arrested, returned, and again advanced forward, more or less quivering on its way, indeed just as a granule or oil-globule in cyclosis is seen to be carried about by the currents of protoplasm in *Closterium*, in the threads suspending the nucleus in *Spirogyra*, &c., in the pseudopodia of the Rhizopoda, in the typical mass of actively moving protoplasm of *Æthalum*, and in the threads which flow from the nucleus in the interior of some of the Diatomeæ themselves (ex. gr. *Surirella*). (2) The locomotive power of the Diatom itself, which is of the same order of movements. (3) The presence of pseudopodial prolongations from this layer, as evinced by the sudden jerk which a body previously attached to the Diatom often presents just after the Diatom appears to have cast off its union with, and is already some little distance from it.

Here it should be remembered that our magnifying powers still, and perhaps ever will, fall far short of demonstrating the slowest locomotion and change of form, the most transparent structures, and the mode of formation of parts in the Infusoria, which, in higher and more visible beings, can be seen to be the product of organs specialized for the purpose. The leg of a *Plaesconia* has, in all probability, as complicated a locomotive apparatus as that of a large Crustacean; and yet it is as transparent and appears to be as structureless as glass under the microscope. Many instances of this occur in Infusoria which are almost large enough to be seen with the unassisted eye; and therefore when we observe the phenomena in the Diatomeæ to which I have alluded, it seems better to let the inferential explanation come from analogy with vital than with physical or chemical phenomena only.

Viewing, then, the movements, &c., of the Diatomeæ as dependent on the presence of an external sarcode, together with their organology internally, there is no class of living beings to which they are so nearly allied as the Rhizopoda, on the animal, and the Desmidiæ on the vegetable side of the imaginary line of demarcation which is supposed to separate these two kingdoms. All the elements which enter into the composition of a Diatom enter into that of certain species of freshwater Rhizo-

poda, as my papers will show. Even the green or chlorophyll-cells found in the latter (e. g. *Diffugia pyriformis* and *Acanthocystis turfacea*, and even brown in *D. compressa*) must be considered the analogue of the endochrome in the former, if indeed the zygosis and formation of a capsuled body may not also be regarded as analogous respectively to the conjugation and formation of the sporangium (see my figures of *Euglypha*, 'Annals,' ser. 2. vol. xviii. pl. 5, and vol. xx. pl. 1) while the skeleton or organ of all is internal, at least so long as the pseudopodia coalesce externally, as they certainly do in some Foraminifera (e. g. *Operculina*).

It is true that most of the Rhizopoda extemporize stomachal cavities in their sarcode for the reception of crude material, which their prehensile power enables them to catch and incept from the exterior, out of which they extract the nutritive parts, and eject the rest. But one group of them (viz. the Acinetina) nourish themselves by sucking out from the interior of other Infusoria material which requires nothing but the process of assimilation to turn it to their purposes, and therefore these, apparently, have not even the rudiment of a stomach; while a step further brings us to the condition of the Diatomeæ, which, like plants, derive their nourishment from the same kind of material in a still more elementary form, dissolved in or disseminated through the medium in which they live. (I once, for two years kept a species of *Chara* in health and vigour by repeatedly adding dead grasshoppers to the water of the jar in which it lived, each time that it grew pale, when the deep green colour of the chlorophyll was restored, and it began to sprout briskly.)

Although the endochrome of the Diatomeæ may not be identical in composition with chlorophyll, still it is strictly analogous to it in other respects. Indeed so far does this extend that there is a large species of *Gyrosigma* in the marshes of the Island of Bombay (figures of which I have preserved) that has four narrow bands of endochrome arranged spirally throughout its interior, identical with the arrangement of those of *Spirogyra*; while the currents of the sarcodal threads internally in *Surirella*, being equally identical with those of the cell of *Spirogyra*, closely ally the Diatomeæ to *Spirogyra*, to say nothing of their identity also in the process of conjugation. Then, again, the filaments of *Spirogyra*, when thrown confusedly into a basin of water, soon arrange themselves into regular parallelism, in which state also they are continually changing their position, and thus affording evidence of their power of locomotion. *Closterium*, among the Desmidiæ, also can attach itself by one of its ends to the vessel in which it may be kept, and give proofs of a locomotive power by constantly swaying the other extremity round in circles. The *Euglenæ* can attach themselves to objects by

their tails, and also move round in much the same manner, which must be effected by a portion of protoplasm outside *their* fibrous cell-skeleton. And the concatenated divisions of *Oscillatoria princeps* can move in a body backwards and forwards in their sheath, which, like that of *Schizonema* among the Diatomeæ, is evidently secreted from their surface. Indeed, innumerable instances might be cited in support of the view that in all these organisms, where there is less discovered to support it even than in the Rhizopoda, there is, including the Diatomeæ, a communication between the interior and exterior of their cells, formed of apertures, however small, which enables the more subtile parts of the protoplasm to obtain connexion with the external world. It is these apertures which M. Garreau (Annals, vol. x. 1862) has asserted to exist in the vegetable cell, and which, as I have before stated, when confirmed, will afford a satisfactory explanation of all that class of phenomena which, but for the establishment of this link, still incline many to attribute them to direct physical causes, instead of regarding them as induced indirectly through the influence and government of vital or instinctive agency. One might say that there was no instinctive agency evinced in a Diatom attaching a particle of foreign matter to its surface, if it had not at the same time the power of retaining or casting it off, or if it adhered to every other particle that came in contact with it, which is not the case.

Indeed several microscopists, among whom are Ehrenberg, Siebold, Föcke, and Wenham, have asserted positively that motor organs exist outside the frustule of the Diatomeæ, in the form of pseudopodia and cirri, cilia, exsertile and retractile feet, and an undulating membrane respectively; and in the subgroup of Rhizopoda to which I have already alluded, viz. the Acinetina, wherein vibratile cilia or tentacula can be projected from the surface, or retracted, as required, with the appearance of extemporization, I have observed all this to take place from a visible sarcode; but I have never seen in the Diatomeæ more than indications of the presence of such an organ externally, which, like the transparent portion of the cortical or non-granular ectosarc of some *Amæba*, presents all the movements of cyclosis when a particle of foreign matter happens to be attached to it, even without itself being visible.

Returning, then, to the question of impregnative generation in the Diatomeæ, it seems to me that, being so closely allied to the Rhizopoda in their organization, they might be inferred, by analogy, to follow the same mode of producing an impregnated generation as *Diffugia*. That this mode has been demonstrated I by no means wish to assert; but observations on the subject, made subsequently to those published in my last communica-

tions to the 'Annals,' still further support me in the views therein announced, viz. that the nucleus furnishes the *sperm*, and some other part of the body of the *Diffugia* the *germ-cells*, which produce the new generation. For in that large species which I have designated *urceolata* in my last communication, and which I have since ascertained to be one of the most persistent and plentiful forms about this neighbourhood, I, last summer, almost invariably found the nucleus (instead of undergoing the change as a whole) to become divided into several spherical cells of equal size, each of which presented bodies in its interior similar to a brood of cells, which, on other occasions and under similar appearances, I have found to issue in the form of ciliated, monadic, polymorphic Rhizopods. With these also were present a number of much larger round and sub-round refractive cells, in which a nucleus was present, but very difficult to be seen, owing to the extreme fineness and apparent homogeneity of the material they contained. There were also several starch-grains present; and on many occasions, but on one in particular, a pair of these *Diffugiæ* in zygosis, when crushed in water under the slide, presented in their interior, besides a great number of the three kinds of cells mentioned, a still greater number of ciliated, monadic Rhizopods, of the size of the bodies in the nuclear cells, and a number of small unciliated *Amæbæ*, about the size of the refractive cells. So far, then, only, do I feel justified in stating that this appears to me to be the mode in which the impregnated generation of *Diffugia* is produced; and if it be so, then all that remains to prove it is the evidence afforded by witnessing the actual union of the ciliated monadic Rhizopods with the unciliated refractive cells—an act which, probably taking place within the body of *D. urceolata* in an undisturbed condition, is not likely to be soon seen among its contents when forced out of the test into water by crushing and the pressure of a glass cover.

Seeing, however, that the Diatomeæ and *Diffugiæ* are thus so nearly allied, and that, in the former, refractive bodies different from the spherical oil-globules in form, together with starch-grains or vesicles, and a granular nucleus, may frequently be found together in the same frustule, it does not seem to me unreasonable, in the absence of more direct testimony, to infer that both in the Diatomeæ and, in *Diffugia* at least, among the Rhizopoda, the mode of producing the impregnative generation may be the same as that described above as the probable process in the latter.

Should this be the case, then the sarcodal cell of the sporangial frustule of Diatomeæ, gaining its exit into the water in its entirety, by bursting asunder the valves of its frustules sub-

sequently to the impregnation of the germ-cells, might sooner or later, under favourable circumstances, assume the cystic form filled with embryos, described by Prof. Smith as the probable ultimate destination of this sac, and actually found by him filled with the embryonal frustules of *Cocconema cistula*, &c., in a gathering of this Diatom which presented "forms of it of every size intermediate between the minutest frustule in the cyst and the ordinary frustules engaged in the conjugating process" (*apud* Pritchard, p. 71).

I have long since figured in the 'Annals' a similar termination to the Rhizopoda in the case of more than one *Amœba*,—that is to say, the parent sac or animal becoming the deciduous cyst of the new progeny.

Again, should this process of impregnation take place in the Diatomeæ, is it not probable that it may also be similar in Desmidiæ, *Euglenæ*, and *Spirogyra*, &c.?

Finally, I have now to allude to the "glair-cell" of the Diatomeæ, a capsuled organ so designated and described by myself in 1856 (*Annals*, vol. xviii. p. 241, pl. 7. figs. 87–91), but not previously noticed, except it be one of the bodies to which the acute observation of the illustrious Berlin microscopist, Ehrenberg, attributed a spermatic function—and never, to my knowledge, since. I must thus again recur to it here, as I have enumerated it among the organs of the Diatomeæ; and in so doing I need not repeat all that has been published upwards of eight years since, further than that this organ has frequently the appearance of an oil-globule, and is conspicuously situated towards each end of the frustule, being double. It, however, differs from the oil-globule in possessing a capsule, in not being of the same form in every genus of Diatomeæ, e. g. *Amphiphora*, where it is skittle- or barrel-shaped (*Annals*, pl. 8. fig. 90, *l. c.*), and in sometimes changing its spherical for a caudate or stellate figure, in *Navicula fulva*, &c., when it loses much of its refractive appearance; while it undergoes duplicative division with the frustule just as much as the nucleus. It seems to have its homologue in the *Euglenæ*, both singly and in duplicate, according to the species; but I have not observed it in any other Infusoria.

Now, if I be right in attributing a spermatic office to the nucleus in *Diffugia*, &c., and the impregnative generation in the Diatomeæ be produced in the same way, it then remains for us to find out from what source the germ-cells are derived.

In *Diffugia* I have recognized nothing like the glair-cell of Diatomeæ, &c., and at present cannot account for the origin of the supposed germ-cells there, unless they be developed from the soft internal part of the sarcode; while, if they be of the

nature of ovules, I cannot divest myself of the idea that they are produced by some ovarian organ.

But, from what has been stated respecting the glair-cell in the *Diatomeæ*, it seems to me not impossible that this may be the organ which here supplies the *germ*—and not the *sperm-cells*, as supposed by Ehrenberg.

EXPLANATION OF PLATE IV.

N.B. All the figures in this plate are drawn upon the scale of $\frac{1}{12}$ th to $\frac{1}{8000}$ th of an inch, together with most of their detail.

- Fig. 1.* *Navicula serians*, Kg. In conjugation, showing formation of the spore or sporangium: *a a*, the pellicle of the gelatinous secretion in which the conjugating frustules first imbed themselves; *b, b*, valves of the two conjugating frustules; *c*, spore or sporangium; *d*, dark shade representing endochrome; *e*, circles representing oil-globules.
- (After this the same parts will be indicated by the same letters, where it seems desirable to insert them.)
- Fig. 2.* The same. The spore divided into two equal portions, each spherical, and surrounded by the capsules, *f, f*, respectively, as indicated by the white interval which separates the dark shade or endochrome from the margin.
- Fig. 3.* The same. The capsules divided in their equatorial lines respectively, and their hemispheres separated for some distance by the sheaths of the sporangial frustules, *g, g*, on which the rings of their more advanced development are not visible, even if formed. The conjugating frustules absent.
- Fig. 4.* The same. Still more advanced state. The rings on the sheath *h* now visible; *h'*, the other half of the spore abortive.
- Fig. 5.* The same. Still more advanced stage; the rings omitted on the sheath which lies inferiorly.
- Fig. 6.* The same. Still more advanced stage: *i*, the interval between the rings in the centre of the sheath.
- Fig. 7.* The same. Still more advanced stage. The undermost half or sheath not seen. Shows the ends of the capsule beginning to disintegrate, *f, f*.
- Fig. 8.* The same. Still more advanced stage. The ends of the capsules disintegrating into short, fusiform, curved, thread-like fibres, *f, f*.
- Fig. 9.* The same. Fully formed sporangial frustule, as seen *within* its sheath.
- Fig. 10.* The same. Empty sheath, showing the longitudinal fissure of dehiscence.
- Fig. 11.* *Navicula rhomboides*, Ehr. In conjugation. The pellicle of the gelatinous secretion and the ends of the capsules absent.
- Fig. 12.* The same. More advanced stage.
- Fig. 13.* The same. Fully formed frustule. Appears broader than the pair of sheaths in fig. 12, probably because their narrow, and not their broad, surfaces are seen. The dark shade on the frustule, which consists of transverse parallel lines, is thus seen under a magnifying power of 800 diameters.
- Fig. 14.* The same. Smaller individuals in conjugation, the valves of the conjugating frustules having a terminal rather than a lateral position as in the larger conjugations.

- Fig. 15. The same, with one division of the spore abortive.
 Fig. 16. The same. Sporangial frustule surmised to be of the size produced by these conjugations. In all these frustules the specific characters are too small to be delineated on the scale to which they are drawn, although perfectly distinct under the microscope.
 Fig. 17. *Pinnularia gibba*, Ehr. In conjugation. The pellicle of the gelatinous secretion and the ends of the capsules absent.
 Fig. 18. The same; more advanced stage. The valves of one of the conjugating frustules absent.
 Fig. 19. The same. Relative size and form of conjugating frustule.
 Fig. 20. The same. Full size of sheath of sporangial frustule in this gathering.
 Fig. 21. The same. Full size of frustule produced by these conjugations.

XIX.—*Description of Helix odontophora, a new Species of the Corilla type, from Upper Ouwah, in Ceylon.* By W. H. BENSON, Esq.

Helix odontophora, mihi, n. sp.

H. testa late umbilicata, rotundato- vel ovato-discoidea, solidula, castanea vel rufescenti-lutea, superne subplanulata, oblique tenuiter costulato-striata, subtus valde concava, striata, nitida; spira planiuscula, versus apicem obtusum elevatiore, sutura impressa; anfractibus 4, primis convexiusculis, ultimo antice convexiore, tum descendente, dilatato-deflexo, subtus valde inflato; apertura perobliqua, obtuse subcordata, lamellis 2 parietalibus (superiore longe intrante curvata, inferiore subparallela, brevior, subcurvata, ab apertura remotiuscula), palatalibus 4 brevibus semilunaribus vel sinuatis (omnibus integris ab apertura conspicuis, extus perlucentibus) coarctata; peristomate purpurascenti-albido vel castaneo, calloso, breviter reflexo, marginibus superiore et inferiore subdentato-incrassatis.

Diam. major 26, minor 19, alt. 8 mill.

„ 22, „ 17, „ 7 „

Habitat in montibus Ceylanicis prope Fort M'Donald, Bandarewella, et Bibiligamua ad altitudinem ped. 4500. Teste Dom. F. Layard.

The examination of a broken specimen of a shell, supposed to be *H. erronea*, which I received from Mr. F. Layard, with the internal lamellæ fully exhibited, convinced me that a peculiar type had been overlooked; and Mr. Layard kindly forwarded to me the shells which he referred to *H. erronea* from Upper Ouwah and Pusilawe: the latter all belong to the true *erronea* type, with three parietal and four lengthened palatal lamellæ, also a single specimen out of five from Bandarewella; the rest all prove to be *H. odontophora*, with only two parietal lamellæ and more delicate sculpture (as in *H. Anax*, mihi, and *H. Humberti*, Brot), only four whorls, and short semilunar or sinuate palatal lamellæ entirely visible from the aperture,—the Fort M'Donald

and Bibiligamua ones exhibiting a chestnut colour, and those from Bandarewella having a paler reddish hue. A single specimen from Fort M'Donald has a fifth short and oblique lamella between the two central ones, evidently an accidental formation. The form of the aperture, that of the palatal lamellæ, the fewer whorls, and the colour as well as the conformation of the upper and lower sides distinguish the species from the Travancore *H. Anax*, notwithstanding the presence, as in that shell, of only two parietal lamellæ.

I have compared sixteen specimens of the new species with forty-seven of *H. erronea*. Two of them, opened, prove that there is no upper parietal lamella in the whole length, invariably to be detected from the aperture in *H. erronea*.

There are now six species known of the Ceylon and Travancore form, as separated from the Burmese *Plectopylis*.

In the 'Annals of Natural History' for August 1859, I stated that the Burmese *H. Achatina*, Gray (*Plectopylis*, nobis, Annals, April 1860), associated by Pfeiffer with the distinct type of *H. Rivolii*, under the name of *Ophiogyra*, and by H. Adams under that of *Corilla*, was ovoviviparous, and remarked that it would be interesting to know whether *H. Rivolii*, &c., were similar in habit. Mr. F. Layard now informs me that *H. Rivolii* and *H. erronea* are not ovoviviparous.

In the note to *H. Anax*, mihi (Annals, Jan. 1865), I referred to Brot's statement that four, and not three, palatal lamellæ occur in *H. Rivolii* and *H. erronea*. Brot omitted to refer to my discovery of this circumstance, recorded in the 'Annals' for April 1860, in the paper on *Plectopylis*.

The lamellæ figured in plate 2. fig. 8, of *H. erronea*, in the 'Journal de Conchyliologie' for 1864 are incorrectly drawn, the connivent parts of the two upper palatal ones being placed at the ends towards the aperture, instead of at the points most remote from it—a feature also observable in *H. Rivolii*. I have not seen a specimen of *H. Humberti*; but there can be no doubt, from the alleged resemblance of the single palatal lamella to the basal one in *H. erronea* (which, however, does not come in contact with the suture), that it diverges from it in the wrong direction in fig. 6. In *H. Rivolii* the basal palatal lamella is nearly parallel with the suture.

A single large specimen of *H. Rivolii*, in Mr. F. Layard's collection, from Moopane, has the two upper palatal lamellæ closely approaching the outer lip. Palatal lamellæ occur at the beginning of the last whorl in *H. odontophora* and *H. erronea*.

Cheltenham, January 30, 1865.

XX.—*Description of a new Genus of Land-Shells from the Island of Labuan, Borneo.* By HENRY ADAMS, F.L.S.

Genus PLECTOSTOMA, H. Adams.

Testa conica, umbilicata; anfractus ultimus solutus, protractus, sursum flectus, inde retrorsum extensus; apertura simplex; peristoma subverticale, expansum.

Plectostoma DeCrespignii, H. Adams.

P. testa elevato-conica, tenuissima, pallido-fulva, laminis numerosis longitudinalibus tenuibus erectis munita, sutura valde impressa, apice subacuto; anfractibus 6, convexis, ultimo tubam protractam, postice paulum constrictam, sursum flectam, inde revertam efformante; umbilico aperto; apertura circulari, subverticali, paululum reclinante; peristomate libero, valde expanso, reflexiusculo. Diam. major 2, minor $1\frac{1}{4}$, axis 2 mill.

Hab. Labuan Island, Borneo.

This minute but very interesting species of the family Helicidæ was found by Mr. De Crespigny, after whom I have named it, in the island of Labuan, Borneo. It appears to have affinities both with the genus *Boysia*, Pfr., and *Hypselostoma*, Bens., from which, however, it differs in having the last whorl constricted at its separation from the others, and in the extraordinary prolongation backwards of the free portion. From *Boysia* it also differs in being more Heliciform, and in having the umbilicus open; and from *Hypselostoma* in the aperture being edentulate.

XXI.—*Diagnoses of new Forms of Mollusca from the West Coast of North America, first collected by Col. E. Jewett.* By PHILIP P. CARPENTER, B.A., Ph.D.

AN account of Col. Jewett's shells will be found in the British Association Reports for 1856 (pp. 226–231) and 1863 (pp. 534–539). The exact localities are often uncertain; but many of them have been fixed by subsequent explorers. Being generally worn beach-specimens, the diagnoses have been written (wherever practicable) from perfect shells, and especially from the beautiful series dredged by Dr. J. G. Cooper, in the Californian State Survey. The types belong to Mrs. Boyce, of Utica, N. Y., and are at present in my keeping. The numbers, in the species from the temperate fauna, refer to the table in the British Association Report for 1863, pp. 636–664.

37 b. *Solen* (? *sicarius*, var.) *rosaceus*.

S. testa *S. sicario* simili, sed minore; multo angustiore, elongata,
Ann. & Mag. N. Hist. Ser. 3. Vol. xv. 12

recta, extus et intus rosacea; epidermide tenui, valde nitente. Long. .27, lat. .5, alt. .32 poll.

Hab. Sta. Barbara (*Jewett*); S. Pedro (*Cooper*).

74. Subgenus AMIANTIS*.

Callista: dente postico utraque valva ruguloso.

Type: *Amiantis callosa*, = *Cytherea callosa*, Conr., = *Dosinia callosa*, Brit. Assoc. Rep. 1857 (from fragments): non *Venus callosa* (as of Conr.), Sow., Rve., Desh.

Hab. Sta. Barbara (*Nuttall, Jewett*); S. Pedro (*Cooper*); Cape St. Lucas (*Xantus*).

This section differs from the typical *Callistæ* as does *Merccaria* from *Venus*. Whether the other peculiarities of the species (redescribed by Reeve as *Cytherea nobilis*) are coordinate, cannot yet be stated, as it stands alone. In sculpture and colour it resembles *Dosinia*; in its ponderous growth, *Pachydesma*.

110. *Lazaria subquadrata*.

L. testa extus *Cardita variegata* jun. simili; pallida, castaneo tincta; subquadrata, antice truncata, subregulariter ventricosa, dorsaliter tumida; costis radiantibus circ. xiv.—xvi., tumidis, nodosis, diagonalibus majoribus; interstitiis plus minusve insculptis: intus, valva dextra dente cardinali triangulari, inter duas fossas sito, haud elongato; dent. lat. a cardine separatis, ant. extante, post. obsoleto, calloso: v. sinistrali dent. card. ii. angustis, subæqualibus, radiantibus; lat. ant. et post. extantibus: cicatr. adduct. subrotundatis. Long. .37, lat. .25, alt. .34.

Hab. Sta. Barbara (*Jewett*); Monterey, and along the coast to S. Pedro (State Coll. no. 403) (*Cooper*).

The outside of this remarkable little species is typically Carditoid; the hinge is intermediate between *Lazaria* and *Cypri-cardia*.

132. *Modiola fornicata*.

M. testa curta, lævi, latiore, maxime fornicata; pallide carnea, epidermide rufo-fusca, rugis incrementi et incrustatione densissime pilosa induta; umbonibus maximis, spiralibus, antice torsis, per tres quadrantes totæ latitudinis devectis; area ligamentali curtissima, arcuata; margine dorsali antice nullo, postice longo, arcuato; margine ventrali recto, vix propter byssum hiantes; postico lato, antico angusto; altitudine dorsaliter valde elevata, ventraliter plane declivi, cuneiformi; umbonibus trans marginem anticum per sextantem totius longitudinis excurrentibus: intus, sub umbonibus excavata; cicatr. adduct. ant. ventraliter sita. Long. 1.4, lat. .76, alt. .95.

Hab. Sta. Barbara (*Jewett*); Monterey (*Taylor*).

* Th. ἀμίαντος, ὁ καὶ ἡ, unpolluted.

160. *Pecten* (? var.) *aquisulcatus*.

P. testa P. ventricosus simili, sed tenuiore, minus ventricosa; costis pluribus angustioribus xx.-xxi.; interstitiis (præcipue valva superiore) fere æqualibus; auriculis magis productis, acutis; sinu serrato: testa jun. interstitiis alte insculptis, laminis concentricis crebris, vix extantibus, interstitia, costas auriculasque transeuntibus. Long. 3.2, lat. 3.35, alt. 1.5.

Hab. Sta. Barbara (*Jewett*); S. Diego (*Cassidy, Newberry, Cooper*).

Intermediate between the tropical *P. ventricosus* and the Atlantic *P. irradians*.

161. *Pecten paucicostatus*.

P. testa subconvexa, vix æquilaterali; castaneo seu rubido seu electrino picta; costis xi.-xv., validis, angustis, rotundatis; interstitiis multo latioribus, subplanatis; tota superficie minutissime concentrice striata; auriculis latis, haud æqualibus, lirulis circ. vi. ornatis; sinu paucidentato: intus pallidiore, linea cardinis costata, ad suturas auricularum tuberculosa; fossa ligamentali curta, transversim lata. Long. 1.7, lat. 1.84, alt. .56.

Hab. Sta. Barbara (*Jewett*); Sta. Barbara Island (*Cooper*).

Pecten (? var.) *squarrosus*. (Page 536.)

P. testa orbiculari, æquilaterali, rubida, albido maculata; valva dextra convexa; costis xviii., æqualibus, testa jun. approximatis, testa adulta interstitiis æqualibus; costis et interstitiis regulariter undatis, striis crebris squamosis radiantibus ubique ornata; auriculis magnis, latissimis, subæqualibus; antica anguste fissata, serrata, postica sinuata; auriculis ambabus et regione contigua scabrose striatis: intus alba, linea cardinali alte sulcata. Long. 1.82, lat. 1.79, alt. .9.

Hab. "Sta. Barbara," teste *Jewett*.

Resembles a shell in Mus. Cuming., marked "*exasperatus*, var.," but does not agree with the diagnosis of that species. All Col. Jewett's valves were dextral. The locality needs confirmation.

183. *Volvula cylindrica*.

V. testa cylindracea, alba, nitente, striis spiralibus distantibus cincta; medio planato, marginibus fere parallelis; antice satis effusa, postice subito angustata; canali brevissimo; labro acuto; labio indistincto; plica columellari parva, valde declivi. Long. .17, lat. .07.

Hab. Sta. Barbara (*Jewett*).

265. *Phasianella* (? *compta*, var.) *punctulata*.

P. testa P. comptæ simili, sed elatiore; suturis impressis; anfractibus

tumentibus; omnino minutissime fusco punctata; columella lacunata. Long. .24, long. spir. .12, lat. .14, div. 50°.

Hab. S. Diego (*Jewett*).

265 b. *Phasianella* (? *compta*, var.) *pulloides*.

P. testa *P. pullo* simillima; solida, compacta, spira brevior; suturis distinctis. Long. .2, long. spir. .1, lat. .13, div. 55°.

Hab. Sta. Barbara (*Jewett*); Monterey, 20 fathoms (State Coll. no. 353). Smaller var., 8–10 fathoms, Catalina Island (*Cooper*).

265 c. *Phasianella* (? *compta*, var.) *elator*.

P. testa perparva; spira elongata, ut in *P. pullo* picta; anfractibus subplanatis; suturis haud impressis; columella haud lacunata. Long. .19, long. spir. .12, lat. .11, div. 40°.

Hab. Sta. Barbara (*Jewett*).

P. compta, with a large proportion of the small shells of the genus, is included under *P. pullus* in Mr. Reeve's monograph. In so difficult a tribe, it is judged better to name the distinct forms, and those from separated localities, until more is known.

276. *Trochiscus convexus*.

T. testa parva, subelevata, purpureo-fusca, tenuiter sculpta; anfr. nucl. ? sinistralibus, vertice quasi decollato; norm. iv., convexis, suturis impressis; obtusissime bicarinatis, striolis confertissimis, minimis, subobsoletis cinctis; umbilico majore, costis duabus cincto, quarum interior acuta, exterior rotundata, crenata; apertura circulari. Long. .15, long. spir. .06, lat. .15, div. 90°.

Hab. Monterey (*Jewett*).

The nuclear whorls in this unique little shell and in the typical species appear sinistral, as in *Phoridæ* and *Solariadæ*. The operculum also resembles that of *Solarium* rather than of *Trochus*. The genus may prove to belong to the Proboscifera, notwithstanding its nacreous texture.

317. *Hipponyx tumens*.

H. testa normaliter fornicata, rotundata, albida; epidermide rugulosa, interstitiis pilulosa; vertice nucleoso nautiloideo, lævi, parum tumente, apice celato, interdum persistente; dein rapidissime augente, expansa, undique regulariter arcuata; liris acutis, subelevatis, distantibus, spiralibus, aliis intercalantibus; lineis incrementi minoribus decussantibus; margine acuto; apertura plerumque rotundata: cicatrice musculari a margine parum remota, regione capitis valde interrupta. Long. .7, lat. .46, alt. .33, div. 90°.

Hab. Sta. Barbara (*Jewett*); S. Pedro (*Cooper*).

= "*H. ? subrufa*" + "*Capulus*, 213," Brit. Assoc. Rep. 1857, p. 230.

329 b. *Bittium* (? var.) *esuriens*.

B. testa B. filoso simili, sed multo minore, graciliore, interdum valde attenuata; sculptura testæ jun. ut in B. filoso, testæ adultæ sub-obsolete; interstitiis haud insculptis. Long. .3, long. spir. .21, lat. .11, div. 25°.

Hab. Sta. Barbara (Jewett); Neeah Bay (Swan); Monterey (Cooper).

334. *Bittium fastigiatum*.

B. testa parva, gracili, pallide rufo-cinerea, marginibus spiræ vix excurvatis; anfr. nucl. iii., lævibus, tumidis, apice acuto; norm. ix., planatis, suturis alte impressis; anfr. primis iii. carinatis, postea costis radiantibus circ. xiii., obtusis, satis extantibus, ad suturas interruptis, interstitiis undatis, liris spiralibus iv. in spira se monstrantibus, costas undatim superantibus, quarum antica in testa jun. plerumque extat; anfr. ultimo parum contracto, basi elongata, liris spiralibus vi. contiguis ornata; apertura gibbosa; labro acuto, interdum varicoso, antice angulatim emarginato; labio tenui. Long. .25, long. spir. .19, lat. .09, div. 20°.

Hab. Sta. Barbara (Jewett).

Genus AMPHITHALAMUS*.

Testa Rissoidea, nucleo magno; apertura labio producto, labro subpostice juncto, subito in adulta contracto.

355. *Amphithalamus inclusus*.

A. testa minuta, lata, solidiore, pallide rufo-fusca; vertice mamillato; anfr. nucl. uno et dimidio, quoad magnitudinem permagnis, minutissime et confertissime spiraliter et radiatim striolatis; anfr. norm. iii., lævibus, subplanatis, suturis impressis; basi subangulata; costa peripherica rotundata, haud extante, interdum in spira se monstrante; costa altera circa regionem pseudo-umbilicarem; labro acuto, haud contracto: labio testa adolescente normali, dein a pariete separata, sinum posticum suturam versus formante, t. adulta valde separata, regionem quasi umbilicarem magnam formante; ad labrum subito fere perpendiculariter, subpostice juncto: operculo tenuissimo. Long. .04, long. spir. .02, lat. .03, div. 60°.

Hab. Sta. Barbara (Jewett); S. Diego (Cooper).

This very remarkable little shell bears the same relation to *Rissoa* that *Stoastoma* does to *Helicina*. The peritreme resembles a figure 6 inverted, as on the face of the type. In the disproportionate size of the nuclear whorls it resembles *Vitrinella*.

373. *Drillia mæsta*.

D. testa acuminata, lævi, dense olivaceo-fusca, epidermide lævi adhærente induta; anfr. nucleosis?... (decollatis); norm. viii., parum

* Th. ἀμφὶ, θάλαμος, having a chamber on both sides.

excurvatis, suturis parum distinctis; testa adolescente costis radi-
antibus circ. x., subobsoletis, elongatis, arcuatis, sinum versus in-
interruptis, postice nodosis; anfr. ult. sculptura nulla; apertura
elongata; canali brevi, aperto; columella recta; labio tenui;
labro acuto, suturam versus sinuato, sinu parvo, expanso; operculo
normali. Long. 1.1, long. spir. .65, lat. .36, div. 27°.

Hab. Sta. Barbara (*Jewett*); S. Pedro (*Cooper*).

386. *Mitromorpha filosa*.

M. testa parva, solidiore, atro-purpurea, subconiformi, antice et pos-
tice subæqualiter tereti; anfr. nucl. ii., albis, lævibus, apice
mamillato; norm. iv., planatis, suturis haud distinctis; omnino
æqualiter spiraliter lirulata; lirulis acutioribus, in spira iv., anfr.
ult. circ. xx., interstitiis majoribus; apertura lineata; labro parum
inflexo, rotundato, postice vix sinuato, intus circ. xii.-dentato;
labio inconspicuo; columella arcuatim truncata. Long. .26,
long. spir. .1, lat. .12, div. 45°.

Hab. Sta. Barbara (*Jewett*); Lower California (teste *Trick*, in
Mus. Cuming).

=? *Daphnella filosa*, Brit. Assoc. Rep. 1863, p. 658, note †.

Mr. A. Adams obtained two similar species from Japan; and
as the shells do not rank satisfactorily under any established
group, he proposes the above genus for their reception. M. Crosse
suggests that *Columbella dormitor*, Sby., may be congeneric.

[To be continued.]

XXII.—On the Classification of Cerambyces, with particular regard to the Danish Fauna*. By Professor J. C. SCHJÖDTE.

I.

It has perhaps not been observed hitherto that the terms *Digitigrada*, *Unguligrada*, and *Plantigrada* fully apply to the Arthropoda, or that the manner in which the animals tread the ground and the corresponding structure of their feet deserve special attention as distinctive characters of classes and orders in this series of the animal kingdom; yet it is so. All Arachnida are Digitigrada. All Crustacea (including the Myriapoda, which merely exhibit the Crustacean type modified for terrestrial life) are Unguligrada; and the same is the case with all larvæ of Insects with complete metamorphosis, and with some of the lower groups of Insects, especially Thysanoura and Siphunculata—the unguligrade Arthropoda being at the same time, with few exceptions,

* Translated from the 'Naturhistorisk Tidsskrift,' ser. 3. vol. ii. p. 483. Copenhagen, 1864. The original is accompanied with an engraved plate containing details of the organs of the mouth.

also Solipeda. With the exceptions just mentioned, all Insects are Plantigrada.

It follows that Insects and Arachnida alone can want *foot-pads*. But whilst in Vertebrata the structure of the foot-pads is principally regulated by the weight of the body, the case is different with the Arthropoda, because of their smaller size, firm external skeleton, and enormous muscular power, together with the increased number and different position of their limbs. Here the object of the foot-pads is solely to assist the animal in standing firmly on the ground, and to prevent the foot from slipping in walking. Only those Plantigrade Insects, therefore, have foot-pads whose mode of life requires that they should move on highly inclined dry surfaces; and accordingly the foot-pads consist of innumerable thick hairs, broader, softer, and more or less divided towards their tips, collectively forming an even and almost smooth surface under the foot, soft as velvet, which slopes outwards towards the point of the foot.

Two sets of neighbouring organs, *spurs* and *claws*, facilitate the working of the foot-pads.

The development of *spurs* depends on whether the legs are constructed for *walking* or for *running*. In the first case the limbs are shorter, all three pairs of equal length, and the joints are during the movement inflected against one another in such a manner that femur and tibia form together nearly a right angle, as well as the tibia and tarsus. The position of the tibiæ is therefore perpendicular; and as the movement at the same time is slow, the foot-pads afford sufficient security against slipping, and the spurs are not at all developed, or, at any rate, they remain very small, almost imperceptible. But if the limbs are calculated for running, they are all proportionally longer, the posterior pairs increasing in length; and the joints are, during the movement, so inflected as to form more or less obtuse angles. The longer the legs are, and the greater the difference in length between the different pairs of legs, the more obtuse do the angles become. The position of the tibiæ is consequently sloping outwards; and, the movement being at the same time fast, the foot-pads do not afford sufficient security against slipping; the spurs are therefore developed in proportion as their assistance is needed.

The *claws* play quite a different part. Indispensable as they are for climbing on perpendicular surfaces, and for security against sudden shocks, the claws would essentially impede walking, and render running almost impossible, on account of their downward direction, curved shape, and sharp points, if there had not been added some contrivance in order to suspend their action whenever their service is not required, and to bring them

into play, without fail or delay, whenever they are wanted. This contrivance consists in the peculiar position of the claw-joint, its articular insertion being effected on a higher plane than that of the other joints, whereby the animal is enabled, at its option, to raise the claws whilst walking or running, or suddenly to drop them and, as it were, cast anchor. Besides, in order to diminish the weight of the claw-joint when raised up, its point of insertion is removed a little upwards, so as to be actually on the upper surface of the tarsus, the joint which carries it being also cloven, partly in order to enable the animal to bring the foot-pads of that joint to a level with those of the first joints of the tarsus, partly in order to afford space for the movements of the claw-joint.

However, something more is evidently necessary in order to make this mechanism work with perfect ease. Without some further contrivance, the position of the claw-joint, when raised up, would become stiff and straddling; and when turned in different directions, its base would always be exposed to getting foul of the upper parts of the lobes of the cloven joint, between which it lies. The reader may realize the arrangement by keeping the first and second finger extended in such a position that they diverge as much as possible, and then imagining that they represent the two lobes of the cloven joint, and that the long claw-joint, furnished with two moveable claws, is implanted in the middle of the slanting surface in the cleft between the two fingers. It will thus easily be understood that all difficulties and impediments to the necessary freedom and delicacy of the movement may be surmounted by inserting a small new piece between the base of the claw-joint and the point of insertion at the bottom of the cleft between the two lobes. This is in reality the expedient chosen; and the nodule observable at the base of the claw-joint is the real penultimate joint of the tarsus, altered to such a degree in size and shape, for the purpose indicated, that many authors entirely disregard it in counting the joints of the tarsus, and describe the large cloven joint as the penultimate, although it is in reality the third from the end.

That this modification of the penultimate joint in the so-called *pseudo-* or *sub-pentamerous* and *-tetramerous* feet has hitherto been considered enigmatical* is principally owing to the authors

* One of the most learned and thinking entomologists of the present day, who, besides, has made a special and comprehensive study of the *Chrysomelidæ*, describes the reduction of the penultimate joint as “une particularité dont l'explication est impossible dans l'état actuel de nos connaissances, et qui ne le sera probablement pas moins quand nous aurons pénétré plus avant dans l'organisation de ces insectes.... Il est d'autant plus difficile de se rendre compte d'un caractère commun à un aussi

creating a difficulty for themselves by supposing erroneously the nodule at the base of the claw-joint to be entirely continuous and forming one piece with the claw-joint itself. Even if it were so, this circumstance would be explicable by the consideration that a sole furnished with foot-pads should not be too long. It is true that this nodule, the true penultimate joint, generally (though not always) remains attached to the claw-joint when this is torn off; and this circumstance no doubt has caused the error of supposing them to form but one joint; but on closer examination a true though not always equally well-developed articulation will nevertheless be found. There are certainly many degrees in the freedom of the articulation, as well as in the size and shape of the penultimate joint; but these will in every case find their full explanation in the particular shape of the cloven joint, the varying depth of the cleft, and the steepness of its sides—a character which has hitherto been so completely overlooked in the numerous and verbose descriptions of species, that I have been able to make the first application of it for the grouping of the species of *Leptura*.

II.

These observations, which I hope may contribute to a clearer appreciation of the *herbivorous* type of foot in Insects, may at the same time serve as an introduction to the following account (which I have rendered as reliable and complete as I could) of the *Cerambyces* hitherto found on the Danish islands, in North and South Jutland. The *Cerambyces* belong, as is well known, to the innumerable host of Coleoptera, of which the distinctive character, according to the systems now generally followed, lies in their possessing pseudopentamerous tarsi. Although I do not contest the expediency of retaining for the present this systematic definition, I am nevertheless unable to admit that character to be essential, because the peculiarity of structure to which it has reference is, in my opinion, not *typical*, but merely *biological*—dependent on mode of life. It may be sufficient here to remind my readers of the restriction and reduction to which it is subjected whenever, and in proportion as, the animal is less

grand nombre d'espèces, qu'on n'aperçoit ici aucune relation de cause et d'effet. Il est aisé d'expliquer pourquoi tous les Subpentamères qui se nourrissent de feuilles ont des tarses larges et garnis en dessous de poils formant une brosse très-serrée; cette structure leur était nécessaire pour qu'ils pussent s'attacher avec force aux surfaces plus ou moins lisses, sur lesquelles ils se tiennent habituellement. Mais dans le cas dont il s'agit on ne voit pas ce que l'oblitération d'un article des tarses peut avoir de commun avec le régime alimentaire." (Lacordaire, 'Monographie des Coléoptères subpentamères de la famille des Phytophages,' i. pp. 15, 16.)

in want of it—for instance, in those *Curculionidæ* and *Chrysomelidæ* which live under water (*Bagous*, &c., *Hæmonia*): nay, in the case of that remarkable genus of Prionini of which the two sexes have been referred to two different genera, the female (*Acanthinodera Cumingii*, Hope) has naked thorny soles, whilst the soles of the male (*Malloderes microcephalus*, Dup.) are furnished with enormous foot-pads. And the same observation which holds good with regard to the systematic definition of the whole division applies equally to its distribution into families. Just as the term *Pseudopentamera* rather describes vaguely than defines systematically a vast division of the animal kingdom, so the family-characters of *Curculiones*, *Cerambyces*, or *Chrysomelæ*, as now understood, in reality indicate merely the different kinds of plants or parts of plants chosen for the support of their young, whether it be root, stem, branch, twig, bud, leaf, flower, or fruit. Thus the general *habitus* of *Cerambyces* is evidently regulated by the circumstance that the larvæ are to live in the interior of stems and branches; hence their greater size, their powerful build, fit for walking, running, and flying, their long antennæ and large eyes—all peculiarities of structure which enable them to find the timber, or the particular spot in the timber, which has exactly the desirable degree of dryness for their offspring; hence, likewise, the often strongly developed difference between the sexes, rendering it easier for the male to find the female; further, the incomplete development of the two lower pairs of organs of the mouth in those cases where the care for the offspring becomes so absorbing as not to leave time for the adult animal to feed; in short, the *Cerambyces* show all those features of *habitus* which are met with in all other insects which stand in a similar relation to the forest, whatever families or orders they may belong to—as, for instance, *Bombyces* amongst *Glossata* and *Sirices* amongst *Piezata*. Nor is there any particular difficulty in explaining the *habitus* of the manifold smaller divisions by similar considerations. No two things could be more congenial than the *habitus* of a *Prionus* and life in the twilight of the forest or in the darkness of night; nothing more natural for the gay *Leptura* than sporting on flowers and sunny shrubs. But to unravel the unknown *type* of which all these hitherto but loosely defined forms are modifications is quite a different problem, for the solution of which far more penetrating studies are required than entomology has hitherto been able to boast of. For the present, my modest endeavour is confined to one family only, that of *Cerambyces*, the classification of which I have tried to place on a new basis in several respects—an attempt which appears called for by the present state of things, inasmuch as it is impossible with any degree of certainty to define the groups by

the present vacillating characters of *habitus*; nor do these characters range together all those genera which, by the structure of their essential parts, belong together.

In this respect I have found it necessary to return to that point to which Fabricius carried our systematic knowledge, and to continue where he left off; for it seems to me that his penetrating eye in this matter fixed upon the only true starting-point. Nor did this at first escape Latreille, as indeed might be expected from this excellent systematic author, whose genius, no doubt, was of the highest order, only wanting greater self-reliance. But we cannot wonder that when Latreille, in his forty-ninth year, had finished the stupendous studies of which he has succeeded in condensing the results into the four small octavo volumes of his master-work, '*Genera Insectorum et Crustaceorum*,' he did not, in the following years of his life, with equal energy continue these researches, but was content, in his numerous later works, to master the new material as well as it could be done by means of his old treasure of knowledge and experience. This treasure was rich enough to enable him to the last to tower far over the heads of all his contemporaries. But an attentive examination nevertheless shows that the immense accumulation of material which took place in the first decenniums of this century (particularly after South America became more accessible to Europeans) by degrees more and more distended, undermined, and at last entirely destroyed the classification of Latreille's younger days. In the '*Règne Animal*' the old structure is hardly to be recognized, half destroyed as it stands there, patched up and extended by numerous slight additions, only incompletely answering their purpose, badly harmonizing with the original simplicity of the structure, obscuring and disfiguring its former noble features. Where much time and labour would have been required in order to treat the new material according to the old method, the more difficult part of the work has been left undone, and new systematic rubrics have been inserted, with far less care than formerly.

It is true that the same may, generally speaking, be said of Fabricius, on comparing those of his works which date from his earlier days with his later publications; but the case is different, because his method, great as the progress was which it involved, nevertheless by its very nature did not allow of extension beyond a certain point without breaking down. The basis and purpose of the Fabrician method was the genus as defined by the organs of the mouth: "*Genera tot sunt, quot similiter constructa instrumenta cibaria proferunt diversæ species naturales*" (Philos. Ent. Dispos. § 6. 1). He did not doubt the existence of natural groups of genera ("classes"); but maintained, "*at nondum*

tempus est eas elaborare, quum tyrones adhuc scientiæ simus” (*ibid.* § 7. 2); and it is evident that such a method would be superseded at once and belong to the past from the moment that Latreille had started the principle of natural families.

Of course it is now easy enough to see that very much might nevertheless have been done by following up the method which Fabricius had so well established, particularly if he had been able to raise himself to a more physiological view of those important organs on which alone he founded his genera; but surely it would have been almost a miracle if he had been able in his old age to adopt the new method—so entirely at variance with the principles he had hitherto followed—which Savigny shortly after took up with such great success. Fabricius would not surrender his scientific supremacy; and the consequence was that, in order to master the fast accumulating material, he was obliged to extend his genera far beyond their capability—fixed, as they had been, in a one-sided manner—and more and more to weaken the systematic importance of the characters, as may be seen in the ‘*Systema Eleutheratorum*.’ Nevertheless it may be said in truth that Fabricius, through his genera founded on the organs of the mouth in connexion with the excellent “adumbrationes,” has constructed the classification of *Cerambyces* in all essential points as it now stands; for since then it has hardly received any improvement, save the useful observations on the relations of the coxæ and trochanters which Spinola has communicated in his well-composed treatise on Prionini, but which are by no means so important as he imagined*. The only difference is that, since Latreille began to attach less systematic importance to the structure of the mouth, the study of its organs has been almost entirely neglected, and the long-winded definitions of thousands of species have been founded entirely on those external characters (as the shape and direction of the head, the position of the antennæ compared with the eyes, &c.) which Fabricius had mentioned only as additions to his principal definitions. The consequence is that the classification of this family, as that of so many others, has sunk into such confusion that the difference between the characters of genera and those of species is on the point of becoming effaced and reduced to a mere matter of taste, so that one might make a separate genus of every species—return, in fact, to the ante-Linnæan standing-point—without overstepping the legitimate consequences of the mode of proceeding now prevailing in the classification of *Cerambyces*.

* Dei Prioniti e dei Coleotteri ad essi più affini Osservazioni del Marchese Massimiliano Spinola (Estr. del vol. v. ser. 2 delle Memorie della R. Accademia delle Sc. di Torino).

III.

The subjoined synoptical table shows what those peculiarities of structure are to which I have drawn attention, as well as what use I have made of them for new characters; and for the better understanding of my ideas I shall here insert a few explanatory remarks, which, however, I am obliged to keep partly in somewhat general terms, in order that they may explain at one and the same time so many and such variously complicated relations, without misguiding as to the details.

It is the different structure of the mouth which regulates the shape and direction of the head, the position of the antennæ, the development of the limbs, the clothing (with hairs, &c.) of the integuments—in short, the whole shape and appearance of the animal. I have here indicated three types of development of the mouth, the peculiarities of which are particularly well indicated by the different development of the third pair of appendages of the mouth—that is, of the stipites of the labial palpi, which either are free and moveable by themselves, or have coalesced with the lingua and thus lost their independent movement, or, finally, have coalesced with each other longitudinally, but not with the lingua, so as to be moveable, but only in unison with each other.

In the *first type*, all parts of the mouth are freely, equally, and harmoniously developed, with the sole view of adapting them for the treatment of pollen, which in that case is the exclusive food of the animal. The mandibles have a vestige of an inner lobe (mala), in the shape of a sharp fold on the under surface, carrying a fringe of setæ. The maxillary lobes are soft, and bordered with a brush of close soft hairs. The lingua is large and thin, divided into lobes clothed with soft close hairs; the fulcrum linguæ is triangular, and does not assume the character of a ligula, as it does not reach the extremity of the lingua; from the surface of the latter arise fringed paraglossæ. In accordance with these peculiarities, the head has an elongated form, the labrum is prominent, covering the organs of the mouth from above; all parts of the animal become elongated, slender, and light, the colour gay, &c.; in short, the whole structure is adapted to a life on flowers. Of course, this combination presents many different gradations; and I have found it difficult to determine what systematic value I should attach to them. After much consideration, I have contented myself with distinguishing between two principal groups, according to whether the mandibles possess a *molar tooth* (mola), properly speaking, or not.

All Cerambyces whose mouth is constructed on the model just described have a small nodule at the base of the mandibles,

convex in some, in others (*Clytus*) even a little depressed in the middle, and sometimes covered with a thin felt. But quite different from this is the large, prominent basal protuberance, with a rough upper surface, to which I give the name of a *molar tooth*. Besides, wherever such a molar tooth exists, there is always found inserted behind it a membranaceous lobe, clothed with felt and armed with bristles; and the fringe on the mandibles above mentioned is also placed, not as usually on the fold of the mandibles itself, but on a separate narrow membrane. Mandibles so constructed indicate the highest development of the mouth on this model: all its parts are lengthened, the lingua exceedingly large and thin, and its marginal fringes, as well as those of the maxillary palpi, are crisped at their extremity. The head becomes still longer, and more or less enabled to turn in all directions by the contraction of the neck, the forehead also affording sufficient room for the insertion of the antennæ without blinding (by emargination) any part of the eyes. The prothorax, which in size must correspond to the narrow neck, has not room for the anterior coxæ, which consequently protrude. In short, we have before us the Cerambycine type modified into the elegant *Leptura*.

Second type.—But, whatever be the food of the animal and the corresponding structure of its mouth, there is still one more circumstance which regulates the form of the mandibles, viz. that the animal by their means only is enabled to work its way out of the timber at the end of its metamorphosis. The mandibles therefore are thick and strong, and furnished with a spoon-shaped excavation at their tip, even when the mouth is constructed on the first type, just described. It is, however, evident that if this type is to be preserved, the size and strength of the mandibles cannot be increased beyond certain limits; and we find accordingly that in the case of those *Cerambyces* whose mouth is constructed on that type the pupa is placed tolerably near the bark, so that the perforation of the timber does not require a greater strength or size of the mandibles than is conformable with the preservation of the characteristic features of the type and with the fitness of the mouth for taking food.

It is quite a different type of mouth that we find in the powerful insects constructed for climbing, digging, and flying afar, and designed by nature to attack the giants of the forest. Here the demands upon the perforating power of the mandibles become so overwhelming that there is neither space nor time nor strength left for developing the mouth for any other purpose. The mandibles are increased in size and modified in shape far beyond the limits allowed by the former type, and become clumsy saws, scissors, chisels, or pincers,—all in the service of

generation alone, and not at all in the service of nutrition. They monopolize almost the whole bulk of the muscles which the head can accommodate. The other parts of the mouth—labrum, maxillæ, and labium—are often, as it were, merely sketched in their development, or play the part only of pads filling up the space round the bases of the mandibles. The maxillæ often remain undeveloped except the palpi, and all parts and appendages of the labium coalesce. Besides, all these animals are active by night, and the large night-eyes leave hardly room enough on the small forehead for the antennæ, which, as we shall explain more fully hereafter, are endowed with peculiar organs of sensation. This is the type represented by the *Prioni* and those other forms which will be subsequently pointed out as their nearest relatives.

Whilst the two types hitherto described are so far connected that the second may be described as a modification of the first, the *third type*, that of the *Lamiæ*, occupies a more isolated place, approaching more to the Chrysomelini. In this type we find the maxillæ and the labium again fully developed; but their more powerful structure, shortness, and spinulous armature show that they are calculated for a more substantial kind of food than pollen. The mandibles are compressed, flat, entirely destitute of fold, fringe, membranaceous margin, or molar tooth; and although their points are well developed for their special use, viz. the perforation of timber, they never assume the shape of pincers, &c., as met with in the Prionini. The lingua is undivided, or only incompletely divided, and the narrowness of the fulcrum linguæ corresponds with the limited strength demanded for the support of the lingua. The labrum is visible; but, as the whole region behind the mouth (hypostoma) is abbreviated, the forehead becomes perpendicular, as indeed befits animals living, in their larval state, in slender pieces of timber, which the perfect insect has to perforate diametrically. In spite of the length of the face, the space available for antennæ and eyes is therefore but small, and a part of the eyes is accordingly blinded.

Having thus placed the organs of the mouth in the foremost rank, I proceed to notice several other peculiarities of structure which have not been taken into due consideration before, but which I think of high systematic value.

Although it is a well-known and often noticed fact that *Cerambyces* are endowed with *organs of sound*, naturalists have hitherto treated these organs with less attention than they deserve. The well-known creaking sound is produced by rubbing the sharp, downward-bent posterior margin of the pronotum against a circumscribed spot on the mesonotum, which spot

shows interferential colours, being covered with extremely close, deep, and minute transverse striæ. At the same time, the fore end of the mesonotum presents a saddle-shaped prolongation, somewhat longer than is required for the purposes of articulation. But all Cerambyces do not possess a creaking apparatus on the mesonotum. There are also mute Cerambyces, viz. all true *Prioni* and some other genera, as *Dorcasomus*, *Molorchus* (excepting *M. major*, L.), and *Vesperus*; and in this case the mesonotum is punctated and hairy, sometimes smooth and depressed, and the prolongation of its fore end is wanting. Of those genera *Dorcasomus* differs from the *Prionini* by the structure of its mouth, on account of which it must be ranked among Cerambycini, *Callidium* being its nearest relative. *Molorchus minor*, L., and *M. umbellatus*, L., are closely allied to *Callidium*; whilst *M. major* has the mandibles provided with a molar tooth, and, upon the whole, in all principal points conforms with the group Lepturini. *Vesperus*, which has been classed with the Lepturini by all systematic authors, on account of its contracted neck, nevertheless differs from them in every essential point, and cannot be united to any other group than the *Prionini*. I have, however, given this remarkable genus a more isolated place in the system, being guided by considerations which I shall next proceed to explain, viz. the structure of its antennæ.

It is principally to Dugès, Erichson, Lespès, and Claparède that we are indebted for studies of the minute structure of the antennæ in Insects. I am quite of the opinion of Claparède when this reliable and ingenious anatomist pronounces the peculiar formations on the antennal club of the Cockchafer to be merely hairs singularly modified*; and I would add that anatomists might have arrived at this result much earlier if they had at the outset taken into consideration other less extreme forms than the antennal club of the Cockchafer; for these remarkable forms of hair are far more commonly met with, and there are many more different types of them, than has hitherto been supposed. Amongst Tenebriones, for instance, there is such an abundance of beautiful forms and rich combinations, that the classification of this large family will come into quite a different groove when once these features are taken into due consideration†. With regard to the occurrence of such hairs in Cerambyces, the following remarks may suffice.

* "Sur les prétendus Organes auditifs des Antennes chez les Coléoptères lamellicornes et autres Insectes" (Ann. des Sc. Nat. 1858, x. p. 243).

† In a great many *Melasomata* (for instance, *Erodius*, *Pimelia*, *Trachyderma*, *Tentyria*, *Elenophorus*, *Psammetichus*) the last joints of the antennæ have their apex crowned by an elegant ring of spines surrounding like a fence the tip of the joint, which resembles a cushion covered with

The antennæ of the *Prioni* appear quite bald when examined by the naked eye or by a glass of moderate power; they may be knotty and thorny, but on the very long forms of antennæ not a single hair is to be discovered; and on the short ones (*Parandra*, *Spondylis*) there are only isolated short stiff bristles, but not the close fine covering of hairs which is observed in other *Cerambyces*. Besides, the surface, at least of the last joints, is either dull or shows interferential colours all over or on some circumscribed spots, being covered with innumerable minute holes. By a proper preparation (for instance, by boiling a piece of an antenna well for a couple of minutes, and then making delicate longitudinal and transverse sections with a very thin knife), the microscope will show that these holes are cauldron-shaped depressions, carrying at their bottom a very short pellucid hair, whilst for the rest the envelope of the antennæ shows the ordinary structure of the external envelope of *Arthropoda*, viz. a great many layers of chitine, which from the inside are perforated by the roots of the hairs which had begun to grow out before those layers were formed.

This description of holes, in which the hair at the bottom is invisible except by means of a strong lens, so that the surface appears bald, I propose to name *pores*; they are found on the under surface of the antennæ, from the third to the eleventh joints, grouped in various ways, which will afford an excellent material for the circumscription and definition of genera. These arrangements may, as far as I have hitherto observed, be described as "poriferous spots" or "poriferous depressions, canals, pore-nets," &c. (areæ, foveæ, foveolæ, canaliculæ, &c., poriferæ), and others, of which the following instances may be mentioned:—

SPONDYLIS.—An oblong, somewhat depressed, poriferous spot on each joint.

THAUMASUS.—A small, deep, irregular depression on each joint.

pores and short hairs. In others of the same family (*Epiphysa*, *Physo-steria*, *Adesmia*, *Zopherus*, *Eurychora*, *Morica*, *Akis*, *Scotobius*, *Asida*, &c.) the pores are furnished with a short felt, and grouped in sharply circumscribed spots and diamonds on the last joints of the antennæ. In *Scaurus* these joints are entirely covered with large short-haired pores; and analogous though somewhat different arrangements are to be observed in *Nyctobates* and allied genera. *Helops* and many other genera have the last joints quite covered with minute hairs, no pores at all being visible outside. The arrangement in *Diaperis*, *Uloma*, and other genera with moniliform antennæ, is very remarkable—the ends of the joints, sometimes also their sides, being occupied by pores of enormous size, closely and regularly placed. These few cursory indications may suffice in order to procure for this phenomenon the attention it deserves.

PÆCILOSOMA.—Many small foveæ on the last joints.

CTENOSCELIS.—A small oval fovea at the end of the third, fourth, and fifth joints; the following joints with a couple of foveæ at the apex and one at the base, the foveæ on the last joints by degrees combining into irregular longitudinal canals.

SOLENOPTERA.—A small fovea at the apex of the third joint and those next following; a greater number on the middle joint, and on the last two joints longitudinal rows of pores.

ÆGOSOMA.—A small poriferous spot at the apex of the third joint; a larger one at the apex of the fourth; on the fifth the same, and an additional spot at the base; on the sixth and following joints the spots at the base and apex confluent, the last joints showing a continuous poriferous surface.

AULACOPUS.—A group of numerous small spots at the apex of the third joint; on the following ones the number of spots increases, so that the terminal end of the antenna is covered with innumerable oblong spots, as if punctated.

MALLODON.—On the third joint a number of oblong foveolæ, which gradually increase in number and length on the following joints; and finally on the last joints combine with one another so as to form partly irregular grooves, partly a net with long meshes.

ACANTHINODERA.—A multitude of oblong foveæ on the third and next following joints, increasing in number on the middle joints, the last being entirely covered with narrow poriferous furrows.

MACROTOMA.—On the third, fourth, and fifth joints a small poriferous spot at the apex; on the sixth a small spot at the base and a more elongated one at the apex; the seventh the same, but with an additional small spot at the apex; on the eighth the spots at the two extremities begin to unite, and the following joints show two or three long poriferous canals.

ORTHOSOMA.—All the joints entirely occupied by long poriferous grooves.

NAOSOMA.—Two small spots at the apex of the third joint; on the fourth, two at the base and two others at the apex; on the following joints the spots more or less confluent; the last joints entirely covered with poriferous grooves.

ENOPLOCERUS.—Two small spots separated by a ridge at the apex of the third joint; and on all the following joints two at the base and two at the top.

ERGATES.—A small spot at the top of the third joint; on the fourth, one at the base and two (a larger and a smaller one) at the apex; on each of the following joints two at the base and two at the top.

CALLIPOGON.—A small spot near the apex of the third joint; two small ones at the apex of each of the following; on the last joints also very small spots at the base; on the two last of all, two elongated spots.

PARANDRA.—Each joint with two deep, oval, poriferous foveæ separated by a sharp longitudinal ridge.

PSALIDOGNATHUS.—A small spot at the apex of the third and fourth joints; on the following, two long deep furrows separated by a ridge.

ANACOLUS.—Two long poriferous canals on each joint.

ANACANTHUS.—A rather short spot on the third joint; a longer one on the fourth; on the following, two long furrows separated by a ridge.

ACANTHOPHORUS.—Third, fourth, and fifth joints with two spots separated by a ridge, which on the following extend to the whole length of the joints, and on the very last combine to form a continuous poriferous surface.

PRIONONEMA.—Two spots on each joint, extending their whole length, and deeper in the male; on the last joint a continuous poriferous surface.

CYRTOGNATHUS.—Third to fifth joints flat underneath, quite covered with pores; on the fourth and fifth joints also a small and narrow spot on the anterior surface; on the following a continuous poriferous surface.

PRIONUS, TRAGOSOMA.—The whole of the antennæ, excepting only the base of the third joint, covered with innumerable small oblong spots with raised intervals, having the effect of a reticulation.

MACRODONTIA.—The spots innumerable, small, scattered over the whole surface, and so close to each other that the intervals form a net.

ERIODERUS.—The under surface of the third joint and all the following joints entirely and closely covered with minute pores.

There is a great variation in the size, depth, shape, and relative position of the pores themselves. Upon the whole, they are somewhat more numerous in the males than in the females. The object of the leaf- or tooth-shaped expansion of the joints so often met with is evidently to gain increased room for pores.

In all other Cerambyces the antennæ are covered with hair, as in Insects generally. The hairs of the pores, being also more or less developed, are generally lost in the multitude of ordinary hairs, so that they can be distinguished only by means of the microscope. In some cases, however, they are grouped together in certain places in such a manner that they are perceptible by means of a moderate lens, and may be used for the purposes of classification. In those genera which form my group *Asemmini* they are collected in spots, in the manner described below. In many *Cerambycini* they are set in long furrows along the under surface of the joint, as, for instance, in *Callichroma moschata*, whose black antennæ, however, on account of their colour, are less suitable for microscopic inspection than the light-coloured antennæ of several exotic species, for instance of *Trachyderes*. Poriferous grooves are sometimes

also observed in the group Lamiini (*Diastocera*, *Ceroplesis*); but in all those short, clumsy, partially apterous forms living in sand-dunes, steppes, and deserts, which are allied to our *Lamia textor*, the hairs of the pores are, as in this species, collected in depressed spots, as, for instance, in *Zographus*, *Penthea*, *Dorcacromorphus*, *Monilema*, *Phrissoma*, *Dorcadion*, and *Parmena*. The silky, alternately dark and light covering of the antennæ of many *Cerambyces* is also to be taken into consideration; but for this the microscope is indispensable; and the different forms are not so sharply distinguished as to be of use for classification.

For the definition of genera and species I have made use of several other peculiarities which have not hitherto been taken into proper consideration, but which require no further explanation here.

I propose the name of "flying-hairs" (*pili volatiles*) for the peculiar, long, soft hairs, pointing out from the body, which are found on the antennæ and limbs, sometimes even all over the body, of certain Cerambyces. I consider it probable that their object is to facilitate the flight by giving the animal greater circumference without increasing its weight in the same degree—a view which is confirmed by the circumstance that these hairs only appear in such genera and species as by their structure in other respects seem less adapted for enduring flight. It is possible, however, that in several cases the rows of hairs found on the antennæ have a different object.

IV.

In *Callichroma moschata* the metasternum is unusually large, and shows in each of its posterior angles a small, narrow, spout-shaped slit. Through these apertures a liquid secretion finds its way out, which causes the peculiar strong smell of this *Cerambyx*. The secretion is produced by a pair of large, flat, bilobate glands containing heaps of glandular cells, the ducts from all the cells of each heap being collected into a bundle. Similar apertures are observed on the metasternum of all the numerous and splendid exotic species of *Callichroma*, both from the Old and the New World, and besides in a series of genera from India and South Africa, particularly *Pachyteria*, *Litoptis*, *Promeces*, and *Polyzonus*. These musk-beetles form a small natural subgroup of their own, united also by other characteristic features, and easily distinguishable by the apertures in question.

The following remarks contain what I have besides to communicate concerning the internal anatomy. It contains the results of numerous dissections of my own at an earlier period,

and of a still more considerable series of valuable dissections which Dr. Meinert, at my desire, has executed during the last few summers, and kindly placed at my disposal.

The *tracheæ* are spacious, and their inner membrane, in all larger stems and branches, also in the antennæ and the limbs, closely covered with long and delicate spines.

The *organs of digestion* are differently developed, in close conformity with the different development of the mouth, as above described, particularly with regard to the size of the stomach and the mass of salivary and intestinal glands. The digestive tube is somewhat longer and better equipped with glands in the female than in the male, but always much longer than the body—in the Lamiini as much as four times the length of the body.

The *salivary glands* are tubiform, more or less ramified, in *Leptura* and *Saperda* forming a considerable bundle. They discharge their secretion into the pharynx, at the base of the maxillæ.

The cavity of the mouth has almost disappeared in the *Prioni*, but becomes more capacious in proportion as the lingua is flatter and thinner; there is an abundance of cuticular glands on the ligulæ and maxillæ. The *pharynx* is narrow, with cuticular spines and short setæ, both roof and bottom abundantly supplied with superficial glands. The *œsophagus* is narrow, opening directly into the pear-shaped *crop*, which in the Lepturini only reaches a little way into the prothorax, but in the other groups extends further back, even into the metathorax. The crop possesses externally smooth transverse muscles, and under them striated longitudinal muscles; the inner membrane is spinulose. The *gizzard* is small, with eight indistinct longitudinal folds, mostly covered with cuticular spines. The *stomach* occupies from one eighth (*Prionus*) to five eighths (*Saperda*) of the digestive canal, and runs straight when it is short; when longer, it presents several windings towards its posterior extremity; and when it is very long, as in *Lamia*, it is convoluted and rolled up like a rope; it has the form of a club reversed, is more or less widened at the top, and its musculature is arranged in rectangular squares. The glands of the stomach, in *Prionus* and *Callidium*, are restricted to the walls of this organ, but, in the other Cerambyces, are placed in numerous cæca of different sizes between the meshes of the musculature; these cæca are long and numerous over the whole stomach in the Lepturini, generally decreasing in number and size towards the posterior extremity, where they are sometimes entirely wanting (in most Lamiini); in some few (*Pogonocherus*) the cæca reappear on the end of the stomach. The *intestine* is first bent forward and upward from

the end of the stomach, then turned back at a very sharp angle, the remainder being straight; the walls are filled with large glandular cells, the muscular membrane with thick annular muscles. The *rectum* is short and flat, without muscular membrane, but with a pair of long and thin muscles at the base.

There are six long, closely convoluted *Malpighian vessels*, which unite, by degrees or all at once, in front of the sharp bend of the intestine; generally they unite by threes, and then combine into one common tube, which is connected with the intestine by a common membrane surrounding both; inside this the common tube generally divides again into single tubes by threes, which wind themselves, without uniting again, inside the covering membrane and outside the intestine, to the end of the intestine, which thereby becomes club-formed. That part of these vessels which is connected with the intestine differs in structure from that which is outside, and particularly in the extraordinary size of the glandular cells.

There are two (in *Prionus* six) pairs of *testes*, which are brick-shaped, rarely globular (*Callichroma*), consisting of a varying number of generally yellowish or reddish folliculi (6-14, *Exocentrus*; 10-30, *Leptura*; 40, *Clytus*, *Prionus*; 70-85, *Callichroma*) disposed in the shape of a rosette close round a common circular disk, often free, but in many species of *Leptura* and *Saperda*, and allied genera, in pairs enclosed in thin bags, which also cover part of the *vasa deferentia*. These latter divide themselves into a number of branches corresponding to the number of folliculi, and show sometimes (in *Clytus*) in their posterior part a spindle-shaped expansion. There are one or two pairs of *vesiculæ seminales* (glandular vesicles), which open at the top of the *ductus ejaculatorius*; in most *Lepturæ* only one pair, short and pear-shaped, in a few (*L. quadrifasciata*) two short pairs; in *Rhagium* and *Toxotus* one pair, long and tubular; in Cerambycini and Lamiini two pairs—either one pair pear-shaped and the other tubular and convoluted (*Prionus*, *Callidium*, *Exocentrus*, *Pogonocherus*), or both short and thick (*Liopus*), or both convoluted and tubular, one pair being longer than the other, sometimes united at the base into one common duct (*Cerambyx*, *Clytus*). In *Callichroma* the arrangement is different: on each side there is a shorter duct divided into several branches, and a longer one divided into a great many branches, which together form a greater bulk than the testes. The *ductus ejaculatorius* is long, the upper end large, more or less club-shaped, often divided into two heads, likewise club-shaped, each receiving a separate *vas deferens* and a separate pair of *vesiculæ semi-*

nales. The upper part of the ductus ejaculatorius is free and convoluted; the lower portion is also convoluted, but encased in a thick muscular covering; its lowest division commences rather wider than the rest, is broad and flat, on the outside strengthened by a pair of chitinous plates, and furnished with retracting muscles, whilst the inner surface is spinulose and carries at its extreme end a chitinous fork, in *Cerambyx* also warts, organs of touch. During the act of copulation the fork is fixed in the vulva, and the whole broader part of the ductus ejaculatorius is turned inside out and pushed into the vagina so far that it reaches the bursa copulatrix, whereby the small spines on the inner membrane of the ductus ejaculatorius become turned outside with this membrane, so that they point backwards, and thus serve to keep the male organs in place during copulation. The penis is formed by two flat chitinous plates joined above and surrounded by two narrow flaps, which above form a continuous ring, and underneath are joined for a part of their length.

The ovaries are divided into numerous ovarian tubes, like the fingers of a hand, the number of the tubes varying from less than ten (*Molorchus*, *Pogonocherus*, *Leptura nigra*, 7-9) to nearly fifty (*Leptura testacea*, 40). The eggs are of a very elongated form, often very numerous, of considerable size when mature. The oviducts are short, their inner membrane spinulose; the common oviduct short. The bursa copulatrix appears as a prolongation of the top of the vagina beyond the point of insertion of the common oviduct: it is short in *Leptura* and *Clytus*, of greater length and formed like a bag with a narrow neck in *Rhagium*, tubular in *Lamia*, distended towards the top end in *Cerambyx*, *Molorchus*, *Liopus*, *Exocentrus*, *Mesosa*. The spermatheca rarely round (*Saperda populnea*), club-shaped (*S. carcharias*, *Mesosa*), or elongated (*Exocentrus*), but generally hook-shaped and somewhat enlarged at the base, with a strong muscle on the concave side; the inner membrane chitinized, brown, or, as in *Saperda carcharias*, black. The ductus spermathecae opens into the vagina at the point where this is joined by the bursa copulatrix. The accessory gland is inserted on the external side and near the base of the spermatheca; its shape is different in different groups, being short and thick, more or less club-shaped, in Cerambycini and Lepturini, but long, flat, and often ramified in Lamiini; it is exceedingly long in *Lamia*, *Mesosa*, highly ramified in *Exocentrus*, with more than one hundred ramifications in *Saperda carcharias*. The ovipositor is long, slender, and constructed like a telescope; the first joint is formed by the bending inwards of the pieces which cover the cloaca or com-

mon vestibule, and possesses near the fore end on each side a glandulous sac producing a lubricatory secretion; the second joint is split on the back, supported by two narrow pieces of chitine ending in a pair of delicately haired palpi. On the piece of chitine which serves as a support for the genitalia, and which is much longer in the females than in the males (reaching in the former sometimes into the very thorax), are inserted four pairs of retracting muscles, viz. one for the vagina, two for the ovipositor, and one for the segments covering the cloaca or common vestibule; the vagina receives a pair of similar muscles from these segments.

There are eight *abdominal ganglia*, the foremost abdominal ganglion being closely joined to the third ganglion of the thorax. The cords uniting the abdominal ganglia are sometimes free and unconnected with one another, sometimes both encased in the same membrane.

V.

The following systematic table is confined to the genera represented in the Danish fauna, but is founded, as the preceding remarks show, on investigations embracing the whole family, as far as the necessary material has been at my disposal. Concerning the leading features of the classification, all that is requisite has already been said, but I shall add a few remarks concerning certain mostly European genera which, according to my view, must find a place in the system different to that they have hitherto occupied. In so doing I refer, amongst the numerous modern books, to the useful work of Mulsant on the French species of Cerambyces, because the classification adopted at present is founded on this work, which may be considered a completion of Latreille's last works.

The exotic genera *Tropidosoma*, *Tragocerus*, *Pæcilopeplus*, *Ceroctenus*, and *Dorcasomus* are to be removed from the group of Prionini to that of Cerambycini. *Spondylis*, which of late has been considered the type of a peculiar group, is to be joined to Prionini. *Rosalia* has free trochanters, and corresponds both in outer shape and in all essential anatomical features to Callidini, from which, however, it is distinguished by a tooth on the back of the mandibles. I suppose that it is owing to merely casual circumstances (as the size and colour, together with its isolated position in the European fauna) that all authors seem to agree in placing it at the side of *Callichroma*, the nearest relatives of *Rosalia* being in reality the American genera *Orthostoma* and *Campocerus*. *Tetropium* (*Criomorphus*) hitherto placed in the group of Callidini, together with *Asemum* and

Criocephalum, hitherto placed in the group of *Hesperophani*, form a new closely united small group *Asemini*, which approaches to *Prionini*. *Hesperophani*, *Clyti*, *Obrüi*, and *Gracilini* are all to be joined to *Cerambycini*. *Necydalini* must be dissolved, *Necydalis* joining *Lepturini*, *Molorchus* *Cerambycini*, both as types of distinct subtribes. *Stenopterus* is closely allied to *Callidini*. *Lamiini* find their place at the end of the family, being considered more allied to *Chrysomelini* than any other *Cerambyces*; and the genera of *Lamiini* are to be distributed between the principal subgroups in a manner differing from the hitherto adopted division into *Lamiæ* and *Saperdæ*. *Vesperus* has to be removed far from *Lepturini*, and to form a peculiar group of its own between *Asemini* and *Prionini*, with which latter it might be united but for the structure of the antennæ. The genera *Rhagium*, *Toxotus*, *Pachyta*, and *Leptura* must be defined in a new manner, entailing a redistribution of species. *Rhamnusium* is to be removed to *Callidini* from *Lepturini*, where authors have hitherto placed it, misled, no doubt, by its deceptive habitus: it is, in truth, of all *Callidini* the one most nearly approaching *Lepturini*.

Amongst the crowd of external characters hitherto used for the classification of the family, but, in my opinion, so floating and so variously combined that they oftener mislead than guide us aright in seeking definite and reliable distinctive characters for systematic divisions, there is one which has done more mischief than any other, viz. the abbreviation and narrowing of the elytra. Just as all natural groups contain genera with different position of antennæ, different shape of hips, and differently developed neck, so most, and perhaps all, groups contain instances of abbreviated or narrow elytra; even amongst *Saperdæ* such may be found, viz. amongst the Indian species and those from tropical Africa (*S. atricornis*, Fabr.). *Necydalini* and *Stenopterus* have been mentioned already. *Odontocera*, *Rhinotragus*, and *Oregostoma* are, on the contrary, allied to *Clytus*, excepting certain species now ranked among *Oregostoma* (*O. albicans*, Kl., and others), but which really belong to quite distinct subtribes of *Cerambycini*, seeing that their second pair of coxæ are quite surrounded by the mesosternum and metasternum, and are not reached by the epimera mesothoracica. In this respect the species in question agree with *Ibidiini*, which may be characterized by this peculiarity of their second pair of coxæ and by their round anterior coxæ with obtected trochanters. Among *Lamiini* the same characters are met with in the American species of *Colobothea*, but not in those of India, which moreover differ by the shoulders of their elytra catching the epimera mesothoracica by means of a process, and by legs of another type.

SYSTEMATIC TABLE OF THE DANISH CERAMBYCES.

I. *Stipites palporum labialium* fixi, basi concreti, linguæ adnati. *Lingua* coriacea vel cornea, brevis, pilosa; ligula et paraglossæ cum lingua confusæ. *Mala maxillarum* coriaceæ vel corneæ, pilosæ. *Mandibulæ* fimbria et mola carentes. *Trochantini* detecti.

1. *Mesonotum mutum*.

A. *Antennæ poriferæ*.

PRIONINI.

* *Antennæ* pilosæ, filiformes, compressæ, areis poriferis magnis, oblongis, concaviusculis, in articulo 3-11^{mo} infra sitis. *Maxillæ* malis binis, minutissimis, coriaceis. *Lingua* biloba. *Pedes* fossorii. *Episterna metathoracica* acuminata. *Prothorax* muticus cordatus.

SPONDYLIS, Fabr.

(*S. buprestoides*, L., rara †.)

** *Antennæ* glabræ, setaceæ, serratæ, areis poriferis numerosis reticulatæ. *Maxillæ* mala interiore nulla, exteriore angusta, porrecta, cornea. *Lingua* truncata. *Pedes* fossorii. *Episterna metathoracica* truncata. *Prothorax* utrinque tridentatus.

PRIONUS, Geoffr.

(*P. coriarius*, L., frequ.)

B. *Antennæ sericatæ*.

VESPERINI.

(Nulli in Dania.)

2. *Mesonotum crepitans*.

C. *Antennæ* pilosæ, areis sensilibus obscuris, in articulo 5-11^{mo} infra sitis. *Pedes* cursorii.

ASEMINI.

* *Femora* petiolato-clavata. *Oculi* divisi. *Palpi* securiformes. *Lingua* biloba. *Antennæ* dense verticillato-pilosæ.

TETROPIUM, Kirb.

(*T. luridum*, L., fr.; *T. fuscum*, Fabr., m. fr.)

† Some of the species here described as rare have hitherto been found only on pine-timber imported from Norway, Sweden, or Germany. However, as a great many species originally thus imported are now common in the Danish pine-forests, no remark has here been made on doubtful cases.

**** Femora fusiformia, compressa. Oculi emarginati. Palpi clavati. Lingua biloba. Antennæ dense pilosæ, in mare infra lanuginosæ.**

CRIOCEPHALUM, Dej.

(*C. rusticum*, L., r.; *C. epibata*, Schjödte, r.†)

***** Femora fusiformia, compressa. Oculi emarginati. Palpi clavati. Lingua truncata. Antennæ brevissime pilosæ.**

ASEMUM, Eschsch.

(*A. striatum*, L., fr.)

II. *Stipites palporum labialium* mobiles, discreti, in fulcrum labii retractiles. *Lingua* tenuis, pellucida, biloba, setulosa, lobis barbatis; *ligula triangularis*, pilosa; *paraglossæ angustæ*, rectæ, dense barbatae. *Palpi* articulo ultimo apice truncato, securiformi vel fusiformi. *Mandibulæ* fimbriatæ. *Stipites maxillares* triangulares.

(*Epimera mesothoracica coxas attingentia*†.)

1. *Mandibulæ* membrana et mola carentes. *Malæ maxillarum* margine membranaceæ, pilis directis dense barbatae. *Lingua* lata, lobis divaricatis, barba directa. *Hypostoma* processu mentigero brevissimo.

CERAMBYCINI.

A. *Trochantini* antichi obtecti.

a. *Prothorax spinosus*. *Mandibulæ* dentatæ, oblongæ.

α. *Glandulæ odoriferæ nullæ. Areæ sensiles antennarum nullæ.*

* *Mala interior maxillarum* brevis, oblique truncata, exterior producta, apice dilatata. *Pronotum* transverse plicatum.

CERAMBYX, L.

(*C. cerdo*, L., fr.)

† This new species, of which two specimens have been found (supposed to have been imported with foreign timber) may coincide with some of the vaguely described North-American species introduced by Kirby, Randall, and Leconte; or, if European, with *C. polonicum*, Motschoulski, or *C. ferum*, Dej. It differs from *C. rusticum* by its darker colour, much more slender limbs and antennæ, by the antennæ being shorter in proportion to the elytra, and by the hind tarsi being much narrower and longer in proportion to the tibiæ (the proportion being 7 to 11 in *C. rusticum*, but 9 to 11 in *C. epibata*), the third joint of the hind tarsi also being bilobate in *C. rusticum*, but merely emarginate in *C. epibata*. Besides, the large impressed points observable on the elytra of *C. rusticum* are hardly to be perceived in *C. epibata*.

‡ This character distinguishes the following genera from certain forms which are not mentioned, being not represented in the Danish fauna, as *Ibidiini* and the American *Colobotheæ*. (See above.)

β. *Glandulæ odoriferæ orificio arytænoideo in angulo utroque posteriore metasterni. Areæ sensiles antennarum canaliculatæ.*

* *Malæ maxillarum angustæ, acuminatæ. Pronotum tuberculatum.*

CALLICHROMA, Latr.

(*C. moschata*, L., fr.)

b. Prothorax inermis. Mandibulæ obscure dentatæ, breviusculæ.

α. *Prothorax globosus.*

* *Palpi securiformes. Elytra integra.*

CLYTUS, Fabr.

(*C. liciatus*, L., r.; *C. arcuatus*, L., r.; *C. detritus*, L., rr.;
C. arietis, L., fr.; *C. mysticus*, L., fr.†)

β. *Prothorax elongatus.*

** *Palpi maxillares producti, securiformes; labiales articulo ultimo fusiformi.*

GRACILIA, Serville.

(*G. minuta*, Fabr., ex Europa meridionali introducta.)

B. *Trochantini* antichi detecti.

a. Mesonotum mutum.

* *Elytra decurtata. Palpi articulo ultimo fusiformi. Antennæ et tibiæ pilis volatilibus. Femora petiolato-clavata.*

MOLORCHUS, Fabr.

(*M. dimidiatus*, Fabr., fr.; *M. umbellatarum*, L., r.)

† The species are thus distributed:—1. Tibiæ without flying-hairs; prothorax, together with the under surface of the body and the thighs, with flying-hairs; the first five joints of the antennæ with a few scattered stiff hairs underneath; prothorax longer than broad, the middle part broadest, the sides steeply arched: ♂, hind thighs reaching the extremity of the elytra; ♀, hind thighs not reaching the extremity of the elytra: (a) forehead vaulted, with a broad, sulcated, longitudinal keel; antennæ filiform (*C. liciatus*): (b) forehead flatly depressed; antennæ setiform, obscurely dentated (*C. arcuatus*, *C. detritus*). 2. Fore and middle tibiæ with long flying-hairs on their hind side; head, prothorax, base of elytra, underside of the body and back side of the thighs with long flying-hairs; antennæ thicker at top, the first five joints showing on the under surface a few scattered long bristles; prothorax as broad as long, broadest in the middle; forehead flat (*C. arietis*). 3. All three pairs of tibiæ with long flying-hairs at their hind side; head, prothorax, base of elytra, under side of the body and back side of the thighs with long flying-hairs; antennæ setiform, first seven joints with a few long scattered bristles on their underside; pronotum broader than long, broadest before the middle; forehead flat (*C. mysticus*).

b. Mesonotum crepitans.

* *Femora* petiolato-clavata. *Antennæ* et *tibiæ* pilis volatilibus. *Palpi* securiformes. *Collum* nullum.

CALLIDIUM, Fabr.

(*C. Bajulus*, L., fr.; *C. undatum*, L., r.; *C. Alni*, L., r.; *C. violaceum*, L., m. fr.; *C. sanguineum*, L., r.; *C. variabile*, L., fr.; *C. clavipes*, Fabr., r.†)

** *Femora* fusiformia. *Antennæ* et *tibiæ* inermes. *Palpi* clavati. *Collum* distinctum. (*Epimera* metathoracica ad coxas decurtata ‡.)

RHAMNUSIUM, Megerle.

(*R. Salicis*, Fabr., rr.)

2. *Mandibulæ* membrana instructæ fimbriata molaque magna, corona planiuscula, apice crispa. *Lingua* ampla, lobis contiguïs, margine rotundatis, barba apice crispa. *Hypostoma* utrinque a genis separatum, processu mentigero distincto. *Epimera metathoracica* coxas supertegentia.

LEPTURINI.

α. Mola mandibularum seriatim mucronulata. Elytra integra.

α. Tarsi postici articulis prioribus tribus scopuliferis. Collum obtuse constrictum.

* *Prosternum* crassum, apice tumidum. *Venter* carinatus.

RHAGIUM, Fabr.

(*R. mordax*, Fabr., m. fr.; *R. inquisitor*, L., fr.; *R. indagator*, Fabr., fr.; *R. bifasciatum*, Fabr., m. fr.)

** *Prosternum* angustum. *Venter* carina media nulla.

TOXOTUS, Meg.

(*T. cursor*, L., fr.; *T. meridianus*, L., fr.; *T. 4-maculatus*, L., r.; *T. interrogationis*, L., rr.)

β Tarsi postici articulo tertio scopulifero.

* *Collum* obtuse constrictum. *Oculi* integri.

PACHYTA, Meg.

(*P. collaris*, L., r.)

† The species are thus grouped:—1. *Epimera metathoracica* continued beyond the hip; the fore hips distant from each other (*C. Bajulus*, *C. undatum*). 2. *Epimera metathoracica* not reaching the hind hips: (a) the fore hips close to each other; the coxal process of the metathorax sharp (*C. Alni*, *C. violaceum*, *C. sanguineum*, *C. variabile*): (b) fore hips separated by a narrow process; the coxal process of the metathorax broad, with an obtuse point; elytra thinly covered with very short close-lying hairs; the flying-hairs of the tibiæ rather short (*C. clavipes*).

‡ This character separates *Rhamnusium* from the first division of *Callidium*. (See preceding note.)

***Collum acute constrictum. Oculi emarginati.*

LEPTURA, L.

(*L. livida*, Fabr., m. fr. ; *L. ruficornis*, Fabr., fr. ; *L. præusta*, Fabr., r. ; *L. lævis*, Fabr., fr. ; *L. 8-maculata*, Fabr., m. fr. ; *L. virens*, L., r. ; *L. scutellata*, Fabr., fr. ; *L. sanguinolenta*, L., fr. ; *L. testacea*, L., fr. ; *L. aurulenta*, Fabr., r. ; *L. 4-fasciata*, L., fr. ; *L. armata*, Herbst (= *L. calcarata*, *L. subspinos*a, and *L. sinuata*, Fabr.), fr. ; *L. atra*, Fabr., fr. ; *L. nigra*, L., fr. ; *L. melanura*, L., fr. ; *L. revestita*, L., r. ; *L. attenuata*, L., r.†)

b. *Mola mandibularum indigeste mucronulata. Elytra decurtata.*

**Tarsi postici articulo secundo et tertio scopuliferis. Abdomen petiolatum. Collum acute constrictum.*

NECYDALIS, L.

(*N. ichneumonea*, De Geer., rr.)

† These species are thus grouped:—1. The extremity of the elytra rounded, the deep impressed line along the seam whole and continued round the extremity of the elytra so as to join the marginal line: (a) the hind thighs not reaching beyond the end of the abdomen; a, third joint of the hind tarsi bilobate; the base of the prothorax with obsolete depressions in the corners, but without a transverse depression across the middle: (*) cheeks as long as clypeus; hind corners of pronotum forming right angles; antennæ thicker towards the top (*L. livida*): (**) the cheeks much shorter than the clypeus; hind corners of pronotum with a short pointed process, turned outwards; antennæ filiform (*L. ruficornis*, *L. præusta*); β, apex of third joint of hind tarsi emarginate; cheeks shorter than the clypeus; hind corners of pronotum with a very short pointed process, turned outwards; antennæ thicker towards the tip (*L. lævis*): (b) the hind thighs reach some way beyond the apex of the abdomen; cheeks as long as clypeus; third joint of the hind tarsi emarginate; pronotum constricted closely in front of the hind corners, which are furnished with a short, pointed, flat process; antennæ filiform (*L. 8-maculata*). 2. The points of the elytra truncated and emarginate; the linear depression along the seam interrupted at the points; cheeks as long as, or longer than, clypeus: (a) hind corners of pronotum forming right angles, without processes; third joint of hind tarsi deeply emarginate (*L. virens*): (b) pronotum contracted closely in front of the hind corners, which show a short blunt process; ♂, antennæ obsoletely dentated from 5th to 10th joint; last abdominal joint bidentate; ♀, last joint of abdomen emarginate, and third joint of hind tarsi bilobate (*L. scutellata*): β, third joint of hind tarsi deeply emarginate (*L. sanguinolenta*, *L. testacea*): (c) hind corners of pronotum with long pointed processes corresponding in shape to the shoulders of the elytra; third joint of hind tarsi emarginate, and pronotum with a deep transverse impression in front of the base (*L. aurulenta*, *L. 4-fasciata*, *L. armata*, *L. atra*); β, pronotum without any transverse impression, but with a slight depression in each hind corner (*L. nigra*, *L. melanura*, *L. revestita*, *L. attenuata*).

III. *Stipites palporum labialium* fixi, toti concreti, in apice fulcri prominentes. *Lingua* coriacea vel cornea, cordata, spinulosa; ligula acuminata, setosa; paraglossæ confusæ cum lingua. *Malæ maxillarum* spinulosæ, exterior angusta, cornea. *Mandibulæ* fimbria et mola carentes. *Palpi* filiformes, articulo ultimo acuminato. *Stipites maxillares* quadrati, margine exterioriore repando. *Tibiæ* anticæ intra oblique canaliculatæ. *Calcaria* brevissima.

LAMIINI.

1. *Coxæ* anticæ globosæ; trochantinis obtectis. *Femora* petiolata, clavata. *Prothorax* spinosus. *Tibiæ* intermediæ tuberculatæ. *Antennæ* annulatæ.

A. *Pedes* inæquales, sensim crescentes. *Tarsi* postici articulo primo longiore quam secundo.

a. *Coxæ* anticæ distantes. Frons planiuscula.

α. *Tarsi* postici articulo tertio scopulifero. *Antennæ* inermes.

* *Antennæ* longissimæ. *Lingua* profunde incisa.

ASTYNOMUS, Dej.

(*A. ædilis*, L., m. fr.; *A. griseus*, Fabr., r.; *A. costatus*, Fabr., r.)

** *Antennæ* productæ. *Lingua* emarginata.

LIOPUS, Serv.

(*L. nebulosus*, L., fr.)

β. *Tarsi* postici articulis prioribus tribus scopuliferis.

* *Antennæ* pilis volatilibus. *Lingua* profunde incisa. *Elytra* apice truncata.

ACANTHODERES, Serv.

(*A. varius*, Fabr., r.)

γ. *Coxæ* anticæ contiguæ.

* Frons convexa. *Palpi* maxillares articulo ultimo attenuato. *Antennæ* pilis volatilibus. *Lingua* emarginata.

EXOCENTRUS, Meg.

(*E. balteus*, L., m. fr.)

B. *Pedes* æquales. *Tarsi* postici articulo primo et secundo æqualibus.

* *Coxæ anticæ* distantes. *Antennæ* pilis volatilibus. Frons planiuscula. *Lingua* vix emarginata. *Palpi* articulo ultimo attenuato.

POGONOCHERUS, Meg.

(*P. fasciculatus*, Fabr., r.; *P. hispidus*, Fabr., m. fr.; *P. pilosus*, Fabr., fr.)

2. *Coxæ* anticæ conicæ, trochantinis detectis.

A. *Prothorax* spinosus. *Tibiæ* intermediæ tuberculatæ.

a. *Antennæ* inermes. *Femora* fusiformia.

* *Antennæ* crassæ, corpore breviores, foveolatæ, sericatæ, infra arearum sensilium duplici serie impressæ. *Lingua* cornea, crassa, truncata. *Frons* convexiuscula. *Tibiæ* posticæ crassæ, tuberculatæ.

LAMIA, Fabr.

(*L. textor*, L., fr.)

** *Antennæ* productæ, infra arearum sensilium duplici serie impressæ, maris granulosa, fœminæ sericeo-annulatæ. *Lingua* apice retusa, laciniis acutis. *Frons* planiuscula. *Tibiæ* posticæ crassæ, apice tomentosæ.

MONOCHAMUS, Latr.

(*M. sutor*, L., r.; *M. sartor*, Fabr., r.)

b. *Antennæ* pilis volatilibus.

* *Femora* petiolato-clavata. *Lingua* emarginata.

LEPARGUS, Schjödte.

(*L. fennicus*, Payk., r.)

B. *Prothorax* inermis. *Femora* fusiformia. *Antennis* pilis volatilibus.

a. *Pedes* æquales. *Antennæ* setacæ, annulatæ. *Lingua* subemarginata.

* *Antennæ* undecim-articulatæ. *Tarsi* dimidiæ tibiæ longitudinis. *Tibiæ* intermediæ rectæ. *Mandibulæ* apice integræ. *Palpi* maxillares articulo ultimo duplo longiore quam tertio. *Coleoptera* tomentosa, apice late rotundata.

MESOSA, Meg.

(*M. nubila*, L. (Gmelin), r.)

** *Antennæ* duodecim-articulatæ. *Tarsi* longitudine tibiæ. *Tibiæ* intermediæ sinuatæ. *Mandibulæ* apice fissæ. *Palpi* maxillares articulo ultimo sesqui longiore quam tertio. *Elytra* fasciculato-pilosa, apice acute rotundata.

AGAPANTHIA, Serv.

(*A. angusticollis*, Gyllh., fr.)

b. *Pedes* inæquales, sensim crescentes. *Mandibulæ* apice integræ.

α. *Antennæ* setacæ, annulatæ.

* *Unguiculi* integri. *Tibiæ* intermediæ obscure sinuatæ. *Coxæ* anticæ distantes.

SAPERDA, Fabr.

(*S. carcharias*, L., fr.; *S. populnea*, L., fr.; *S. scalaris*, L., r.; *S. Tremulæ*, Fabr., r.)

β. Antennæ filiformes. Unguiculi dentati. Tibiæ intermediæ sinuatae. Coxæ anticæ appropinquantes.

† Antennæ tomentosæ.

* *Elytra* apice truncato-rotundata. *Frons* convexa. *Oculi* divisi.

TETROPS, Kirb.

(*T. præusta*, L., fr.)

†† Antennæ sericatae.

* *Elytra* apice acuminata. *Frons* planiuscula. *Tibiæ* intermediæ incurvæ.

STENOSTOLA, Dej.

(*S. nigripes*, Fabr., fr.)

** *Elytra* apice truncato-emarginata. *Frons* convexa. *Scutellum* truncatum, brevissimum. *Tarsi* dimidiæ tibiarum longitudinis. *Abdomen* thorace cum capite longius.

OBEEA, Meg.

(*O. linearis*, L., r.)

*** *Elytra* apice truncato-emarginata. *Frons* convexa. *Scutellum* triangulum. *Tarsi* tibiis tertia parte breviores. *Abdomen* longitudine thoracis.

PHYTÆCIA, Dej.

(*P. cylindrica*, L., fr.)

XXIII.—Description of a new Characinoid Genus of Fish from West Africa. By Dr. ALBERT GÜNTHER.

[Plate V.]

A SMALL collection of reptiles and fishes from the western coast of Africa, just procured for the British Museum, contains a single example of a Characinoid form which is of great interest, inasmuch as it is allied to *Ichthyborus**, a genus from the Nile, which, till very recently, was scarcely known. It differs so materially from the East-African form, that it must be referred to a separate genus, which I name

PHAGO.

In general appearance strikingly similar to *Spinachia*. Dorsal

* Kner does not appear to have been aware that these fish were known already to Joannis, and that I had founded a genus for them, when he published his genus *Psalidostoma*, which is evidently identical with *Ichthyborus*. *Psalidostoma caudimaculatum*, Kner, is probably synonymous with *Ichthyborus microlepis*, Gthr.

fin short, occupying the middle of the length of the body; adipose fin slender, styliform, slightly dilated at its extremity; anal short; caudal deeply forked, not scaly; ventrals scarcely in advance of the dorsal. Body low, elongate, tapering behind, covered with very large, hard, rugose scales, which have the margin serrated; the scales are imbricate, and form a complete, hard carapace. Lateral line uninterrupted; belly flat, head elongate, entirely osseous, the cheeks being covered by the very large infraorbital bone. Snout elongate, conical; cleft of the mouth wide, the angle of the mouth being situated just before the eye; the intermaxillaries and maxillaries of both sides coalesce, forming a very moveable flattish bone, which is armed with a series of strongish, compressed, tricuspid teeth round its entire margin, without canine teeth in front; another series of minute teeth runs along the inner edge of the bone. The dentaries of the mandible also are coalescent into a single bone, without median suture; their dentition is the same as that of the upper jaw. Both jaws are equally moveable in a vertical direction; and when the lower is pressed downwards, the upper is moved upwards at the same time; they shut spontaneously. Palate toothless. Nostrils on the upper surface of the head, in front of the eye, close together. Gill-openings of moderate width, the gill-membranes being attached to the isthmus.

Phago loricatus.

D. 12. A. 10. P. 9. V. 8. L. lat. 47. L. transv. $1\frac{1}{2}/3$.

The depth of the body is rather less than one-half of the length of the head, which is nearly one-fourth of the total (the caudal not included). Eye of moderate size, occupying the middle of the length of the head; its diameter is less than the width of the interorbital space, and two-fifths of the length of the snout. Intermaxillary and mandible with twenty teeth on each side, in the outer series. Operculum small, with rather a deep notch just above the hinder angle of the suboperculum. The origin of the dorsal fin is somewhat nearer to the extremity of the snout than to the root of the caudal fin; it is higher than long. Caudal with the lobes tapering, half as long as the head. Pectorals as long as ventrals, or as the postorbital portion of the head. The portion of the tail behind the anal is much elongate, and a transverse section would have the form of a regular hexagon. Uniform reddish shining silvery; vertical fins with brown dots; each caudal lobe with three oblique brown bands.

Length $4\frac{1}{2}$ inches.

XXIV.—*Observations on Raphides and other Crystals in Plants.*
By GEORGE GULLIVER, F.R.S.

[Continued from p. 40.]

Liliaceæ.—Of this order we have already seen ('Annals,' Jan. and April, 1864, pp. 42, 293) how some plants abound in, while others are devoid of raphides; and numerous subsequent observations have confirmed and extended those formerly made. I have never failed to find raphides in the leaves and some other parts examined of the following plants:—*Funkia Sieboldiana*, *F. purpurea*, *F. undulata variegata*, *Hemerocallis odora alba* and two other species, *Endymion nutans*, three species of *Muscari*, four species of *Scilla*, three species of *Ornithogalum*, *Asphodelus luteus*, *Asparagus officinalis*, *Convallaria majalis*, *C. fragilis*, *Polygonatum multiflorum*, *Maianthemum bifolium*, *Ruscus aculeatus*, *R. Hypoglossum* (raphides scanty in leaves, but plentiful in perianths of these two species of *Ruscus*), *Dracæna terminalis*, *Agapanthus umbellatus*, *Lachenalia intermedia*, *L. tricolor*, *L. pendula*, *Tritoma Uvaria*, and *T. media*.

On the contrary, I have never yet found raphides in many other plants of the order, even after repeated examinations of specimens from different localities, and still more frequent comparative trials, at all seasons, of a few species growing side by side, in my garden, with raphis-bearing plants of this and other allied orders. The following is a list of *Liliaceæ* in which raphides were not found:—One species and several garden varieties of *Tulipa*, *Fritillaria Meleagris*, *Lilium candidum*, *L. Martagon*, *L. aurantiacum*, nine species of *Allium*, *Lloydia serotina*, *Gagea lutea*, and *Simethis bicolor*. Of these last three plants I have only seen dried portions; and a dry and fresh leaf of *Maianthemum* and one growing plant of *Convallaria fragilis*. In the leaf and bulb of *Erythronium dens canis* raphides were not found, though a very few small raphis-like objects were seen in the roots; in which respect this plant resembles certain *Melanthaceæ*, as *Colchicum* and *Bulbocodium*, noticed in the 'Annals' for April 1864, p. 294.

Crystal Prisms in Liliaceæ.—There are some plants of this order in which, together with either a want, scarcity, or plenty of true raphides, larger crystal prisms occur more or less abundantly, as may be well seen in *Phormium tenax*, and in the species of *Tritoma*, *Dracæna*, *Muscari*, and *Yucca*. These prisms, as described in former communications ('Annals,' Sept. 1863, April, May, and Oct. 1864, and Jan. 1865), differ remarkably from regular raphides, and occur in many *Dicotyledones* and

Monocotyledones—for example, in *Bugainvillea*, *Quillaja*, and *Guaiacum*, and in certain Amaryllidaceæ, Bromeliaceæ, Pontederiaceæ, &c., but, so far as my observations have yet gone, are more generally found in the leaves and different parts of Iridaceæ than in any other order.

These prisms differ also, in their greater length and size, from other smaller prisms, such as those of which the ends project in the form of short points on the surface of many sphæraphides, as may be seen in various Cactaceæ and other Dicotyledones. The prisms of Iridaceæ, &c., are likewise larger than the small prisms which occur separately in the bulb-scales of certain Onions ('Annals,' April 1864, p. 293). In *Allium* these short prisms appear to be composed of oxalate of lime and magnesia, and the larger prisms in Iridaceæ of oxalate of lime, as more particularly noticed in the 'Annals' for June last.

Distribution of Raphides in Liliaceæ.—How far the raphidian character may assist in perfecting a natural definition of this order and its subsections can only be determined after much more extensive observations than I have been able to make. But the present limited ones show Tulipeæ and the Onions regularly devoid of raphides, while Hemerocallideæ, Asparageæ, and the Squills as constantly abound in raphides. Considering only our indigenous plants, specifying the tribes as they stand in Prof. Babington's 'Manual of British Botany,' the results, so far as they at present appear, are as follows:—I. Tulipeæ: all regularly destitute of raphides. II. Asphodeleæ: *Gagea* and *Allium* without raphides, while *Ornithogalum* and *Scilla* abound in raphides. III. Anthericeæ: no raphides found in a dry bit of *Simethis*. IV. Hemerocallideæ: both plants abounding in raphides—which also occur plentifully in every plant (except *Ruscus*, in which they are scanty) of the order Asparagaceæ, standing apart, in Prof. Babington's book, from Liliaceæ.

As an example of the value of the raphidian character, so far as regards our native Liliaceæ, I have always found it easy to distinguish by it, in minute fragments of the leaves alone, a plant of Hemerocallideæ from one of Tulipeæ.

Juncaceæ.—A few small raphides occur in the leaf of *Narthe-cium ossifragum*; but I have in vain searched for them in the indigenous species of *Juncus* and *Luzula*.

Edenbridge, Feb. 15, 1865.

[To be continued.]

XXV.—Contributions to an Insect Fauna of the Amazons Valley.

COLEOPTERA: LONGICORNES. By H. W. BATES, Esq.

[Continued from vol. xiv. p. 24.]

GENUS CARTERICA, Pascoe.

Pascoe, Trans. Ent. Soc. Lond. iv. (1858) p. 250.

With this genus commence the more elongated and narrow forms which distinguish the typical Colobotheinæ. The elytra are nearly parallelogrammic, especially in the male sex; in the females slightly dilated a little before the apex. The head is somewhat narrow, and the bases of the antennæ rise from distinct antenniferous tubercles. The antennæ are greatly elongated, and, from the third joint, very slender—the basal joint being longer than the third, and thickened from the base to near the apex. The prothorax is rather short, much narrower at the base than the elytra, and its widest part is at some distance from the base, where it forms, on each side, an obtuse prominence. The humeral angles of the elytra are prominent, and a distinct, but not polished, ridge proceeds from them towards the apex; the surface of the elytra is ribbed, and the apex is truncate, with the outer angle alone prominent and dentiform. The sternums are narrow and plane. The abdomen is slender and tapering, and the terminal segment elongated, especially in the female. In *C. cinctipennis* the ventral plate of the female is subtubular and truncated at the apex, the dorsal obtusely rounded: in the male the dorsal plate is notched at the apex; in *C. cincticornis* the apical segment is shorter and obtuse at the apex. The legs are slender, the basal joint of the tarsi much elongated: the fore tarsi are simple in both sexes.

1. *Carterica cinctipennis*, Pascoe.

Carterica cinctipennis, Pasc. Tr. Ent. Soc. Lond. iv. 1858, p. 250.

C. colobotheoides, Thomson, Classif. des Cérambycides, p. 19 (1860), sec. Chevrolat, Journ. Ent. i. 188.

C. ochraceo-fulva, vertice vittis duabus, thorace vitta lata mediana alteraque angustiorie lateral usque ad oculos extensa, pectoris lateribus, femoribus tarsisque apice, tibiis et antennis nigris, his articulis intermediis basi piceis: elytris nigris, utrinque tricostatis macula humerali margineque fulvis, pone medium fascia testacea ad suturam interrupta. Long. $4\frac{1}{2}$ –6 lin. ♂ ♀.

Mr. Pascoe described this as a new species, believing it, after careful examination, to be distinct from the *S. mucronata* of Olivier, a species closely resembling it; but Prof. Gerstaecker, in the Berlin 'Bericht' for 1858 (p. 117), believes the two to be the same, "the description of Olivier being much more indicative than his figure." It is a generally distributed insect

throughout the Amazons region. I did not find it on timber, but on the leaves of trees in the forest.

2. *Carterica cincticornis*, n. sp.

C. minor, modice elongata, depressa, setosa, nigra; capite (occipite excepto), vitta lata laterali thoracis, macula parva humerali femorumque basi fulvo-testaceis; antennarum articulo quarto late testaceo annulato, primo infra ciliato; elytris pone medium paulo ampliatis, apices versus leviter attenuatis, supra grosse punctatis, bicostatis. Long. 2-3 lin. ♂.

Head short, forehead convex, tawny testaceous; antenniferous tubercles and two broad stripes behind them, united on the occiput, black. Antennæ twice the length of the body, black, the fourth joint, with the exception of the apex, pale testaceous; clothed with short setæ, the basal joint furnished beneath with a fringe of long hairs. Thorax scarcely convex, lateral prominences placed at a short distance from the base; black, with a silky fulvous vitta on each side. Elytra depressed, shoulders obtuse, lateral carina proceeding thence prominent, but not visible from above, slightly dilated from the middle to near the apex, then more suddenly attenuated, apex sinuate-truncate with the sutural angle rounded and external angle produced into a stout tooth; surface clothed with erect brown setæ, coarsely punctured, except near the apex, and traversed by two faintly elevated costæ, both of which disappear before reaching the apex. Prosternum reduced to a very narrow thread; mesosternum also extremely narrow. Abdomen blackish, clothed with grey pile. Legs moderately slender, basal joint of the posterior tarsi a little longer than the remaining joints taken together; black; coxæ and basal halves of the thighs tawny testaceous.

Eggs, rare. I met with two examples only of this pretty little species: its habits are probably very similar to those of *C. cinctipennis*, it being found only on the leaves of trees in the shades of the forest. The depressed body, somewhat dilated elytra, and fringed basal joint of the antennæ are so many points of approximation to the genus *Sparna* of Thomson (*Systema Cerambycidarum*, Liège, 1864, p. 30), the species of which resemble the dilated forms of the family Lycidæ.

Genus COLOBOTHEA, Serville.

Serville, Ann. Soc. Ent. Fr. 1835, p. 69.

The typical forms of this genus are well known to all who occupy themselves with the study of exotic Coleoptera. They are known by their elongate, narrow, and compressed form of body—the vertical, deflexed sides of the elytra being separated from the dorsal surface by an elevated line, which proceeds from

the ridge formed by the shoulders, and disappears before reaching the apex. The elongated basal joint of the antennæ has the same outline as in the great body of the *Acanthocinitæ* previously described. The anterior coxæ are somewhat globular, and the acetabular suture is quite closed; both pro- and meso-sterna are plane, the former being very narrow and the latter subquadrate, narrowed behind. The apical segment of the abdomen is not prolonged into an ovipositor in the female; it varies so much in form in the two sexes, especially as to the outline of the apices of the ventral and dorsal plates, that it affords no constant characters for the formation of groups within the genus. The males are larger and more robust than the females, the anterior legs also being longer and stouter, and having dilated and fringed tarsi. In these typical forms the body is somewhat depressed above, with a very gradual and slight slope posteriorly; with this the elytra are narrowed nearly in a uniform degree from base to apex, and the thorax is widest at its hind angles, with a gradual attenuation from its base to its apex.

These characters, however, do not hold together so as to form a well-defined genus. Some species, which in all other respects are true *Colobothææ*, recede from the typical forms in the shape of the thorax. Thus *C. Schmidtii* has a thorax approximating to that of some members of the *Leipodine* group, having a lateral tubercle towards the hind angles; and *C. lineola* presents a thorax of nearly the same form as *Edopeza*, *Trypanidius*, and the allied genera. The dilatation of the male tarsi also fades away from species to species, and some of these aberrant forms have the elytra less depressed and more narrowed near their apices than in the more typical *Colobothææ*. Notwithstanding this diversity, I have failed in my attempts to divide the genus. One of the aberrant forms constitutes the genus *Priscilla* of Thomson (*Systema Ceramb.* p. 30). It is much less elongate and more convex than the true *Colobothææ*, and the shoulders of the elytra form a larger and more elevated ridge; I have not ventured, however, to separate it from the rest whilst many other species equally entitled to form distinct genera remain in the genus.

§ I. Fore tarsi not more dilated in the male than in the female. Thorax narrowed at the base, and tumid or tuberculated behind the middle on each side.

I. *Colobothæa lignicolor*.

C. modice elongata, brunnea cinereo nigroque variegata, corticis fragmentum simulans; elytris apices versus subito attenuatis, apicibus minus late sinuato-truncatis utrinque bispinosis, dorso costatis. Long. 6 lin. ♀.

Head clothed with tawny-brown pile. Antennæ twice the

length of the body (♀), brown, bases of the joints pale ashy, basal joint ringed with ashy. Thorax widened from the front to the lateral tubercles, which are short and acute, then strongly attenuated and incurved to the base; surface convex, varied with light and dark brown, and with two black vittæ each interrupted in the middle; side, below the tubercle, black, shiny. Elytra short for this genus, broad at the base, gradually attenuated to near the apex, thence suddenly attenuated, making the truncated apex narrow; sutural spine short, external one elongated; shoulders advanced and rounded, lateral carina strongly pronounced and polished, deflexed sides coarsely punctured and with a smooth carina; surface longitudinally convex, setose, and punctured; two short, rugose, slightly elevated carinæ near the base, and one longer and smoother along the disk; the colour is brown varied with ashy, near the scutellum is a dull blackish patch, and behind the middle is an oblique black streak; the anterior part of the disk is ashy, and there is a triangular ashy spot near the apex. Body beneath black, with grey pile; a row of ashy spots on each side the abdomen. Legs shining pitchy red, spotted with grey.

♀ Terminal ventral segment broadly and triangularly excised, angles prolonged into acute spines. Dorsal segment broadly truncated.

On a bough of a dead tree, forest, Ega. There is a closely allied and similarly coloured species found at Cayenne*.

2. *Colobotheca velutina*, n. sp.

C. elongata, parallela, convexa, antice et postice declivis, thorace velutino-nigro vitta laterali fulva; elytris griseis fulvo nigroque maculatis, regione scutellari, maculis lateralibus duabus undulatis plagaque quadrata apicali purpureo-nigris carneo-fulvo cinctis. Long. 6-7 lin. ♂ ♀.

Head brown, a fine central line on the vertex and a broad stripe down each cheek tawny ashy. Antennæ one-third longer

* *Colobotheca ligneola*. Parum elongata, angustata, brunnea, cinereo nigroque varia, corticis fragmento simillima. Caput piceo-fuscum. Antennæ piceæ, articulis basi cinereis. Thorax cinereo-fuscus, vittis duabus nigris, lateribus nigris politis; convexus, prope basin sinuato-attenuatus, tuberculis lateralibus obtusis. Elytra brevia angustata, apices versus citius attenuata, apicibus sinuato-truncatis angulis suturalibus distinctis exterioribus productis; supra grosse punctata, prope basin et disco breviter costata, brunneo cinereoque varia, vitta brevi suturali maculaque discoidali (lineola cinerea divisa) saturatoribus. Corpus subtus nigrum politum, cinereo varium, abdomine lateraliter cinereo maculato: pedibus piceo-rufis, griseo maculatis. Fœminæ segmento ultimo ventrali attenuato, apice sinuato-truncato bispinoso; dorsali apice rotundato, medio unidentato. Long. 3½ lin. ♀. *Hab.* in Cayenna, a Dom. Bar lecto.

than the body, black (dark red towards the base), the fourth joint with a grey, the sixth with a white ring. Thorax with a distinct tubercle standing out from each side at a short distance from the base, scarcely narrowed behind the tubercle, hind angles slightly prominent; surface velvety purplish black, with a tawny-ashy stripe on each side having a blackish line in its middle, sides below this with a shining black stripe. Elytra moderately elongate, and scarcely tapering from their base to near their apex, whence they are distinctly narrowed to the apex, the latter broadly truncated, the sutural angle of the truncature scarcely distinct, outer angle produced into a longish and acute tooth; the surface is convex, setose, and moderately punctured, partly in rows; the colour is grey sprinkled with blackish spots, and ornamented with large purplish-black patches—namely, one semi-circular, over the scutellum, a second angular, on the side near the base, a third of zigzag outline, beyond the middle, and a fourth quadrate, close to the apex; all these spots are margined with pinkish tawny, but the apex is narrowly edged with grey. Body beneath tawny; abdomen grey in the middle and spotted with black on the sides, the apical segment shining black with two basal greyish spots. Legs black, with grey and tawny-grey rings; fore tarsi simple in both sexes, but the legs of the male are visibly stouter than those of the female.

♂ ♀. Terminal ventral segment sinuate-truncate, angles produced into short and not very acute spines: dorsal segment obtuse. The whole segment is much longer in the female than in the male.

Common on felled trees in the forest throughout the Amazons region. Also taken at Cayenne. An allied but quite distinct species is found in Venezuela*.

3. *Colobotheca decemmaculata*, n. sp.

C. elongata, angustata, postice flexuoso-attenuata, carneo-cinerea maculis oblongis lateralibus nigro-velutinis læte ornata: thorace

* *Colobotheca maculicollis* (Chevrol. MS. sec. Dom. Deyrolle). Elongata, parallela, modice convexa. Caput sordide cinereum. Antennæ vix corpore longiores (♀?), fuscæ, articulis 4^{to} 6^{to} 8^{vo} et 9^o cinereo annulatis. Thorax paulo ante basin tuberculo majore conico armatus, sordide cinereus (lateribus inclusis), medio dorsi macula oblonga velutino-purpurea ornato. Scutellum velutino-purpureum, medio macula parva cinerea. Elytra imprimis paulo, apices versus citius attenuata, flexuoso-truncata, angulis suturalibus nullis, exterioribus spinosis; supra punctata, grisea, fusco maculata, utrinque maculis majoribus velutino-purpureis tribus ornata, prima parva laterali ante medium, secunda magna triloba pone medium, tertia obliqua valde angulata ante apicem, totis carneo-fulvo partim marginatis. Corpus subtus fulvo tomentosum, abdomine nigro lateribus fulvo maculatis. Pedes nigri, fulvo annulati. Fœminæ (?) segmento ultimo ventrali truncato angulis vix productis, dorsali obtuso. Long. $5\frac{1}{2}$ lin. Hab. Venezuela. Coll. Bates.

utrinque paulo ante basin tumido, deinde paulo constricto; pedibus rufis, griseo annulatis. Long. $5-6\frac{1}{2}$ lin. ♂ ♀.

Head reddish, cheeks and vertex each with a pinkish-ashy stripe. Antennæ one-fourth longer than the body, dark red, becoming blacker towards the apices and greyish at the bases of the joints. Thorax widened from the front to a short distance from the base, where it is tumid on each side and after that constricted; surface pinkish ashy (the tomentum very compact), each side occupied by a broad velvety-black vitta, below this is a pinkish-ashy stripe succeeded by another black one. Scutellum pinkish tawny. Elytra elongated and tapering from base to apex, but appearing to have a flexuous outline, from the great prominence, after the middle, of a raised line which runs along the deflexed sides very near to the extreme margin; apex obliquely sinuate-truncate, sutural angles prominent, external angles produced into a long spine; the lateral carina proceeding from the prominent shoulders runs in a strongly flexuous course to near the apex; surface punctured, pinkish grey, and ornamented, on each elytron, with four rich velvety-black spots, namely, one triangular in the middle of the base, a second long and oblique, stretching from under the shoulder to the disk of the elytron, a third, angulated, behind the middle, and a fifth, oblique, near the apex, all margined with pinkish tomentum. Body beneath blackish, clothed with grey pile; breast red. Legs red, ringed with grey; fore tarsi simple in both sexes.

♂ Terminal ventral segment with a broad triangular excision, angles acute; dorsal segment obtuse, narrowly notched in the middle.

♀ Terminal ventral segment with a deep semioval excision, angles acute but not produced; dorsal segment with a broad notch in the middle.

This extremely beautiful species was rare. I met with it only at Obydos and on the banks of the Tapajos. It is found in Cayenne, and I have adopted the MS. name under which it exists in some collections in Paris.

4. *Colobothea flavomaculata*, n. sp.

C. parva, angustata, postice attenuata, purpureo-nigra; capite lineis tribus, thorace lineolis transversis lateralibus alteraque dorsali, elytris maculis sex apiceque sulphureis. Long. $3\frac{1}{2}-4$ lin. ♂ ♀.

Head black, front with three sulphur-yellow lines, the middle one extending to the occiput; cheeks with a yellow line behind the eyes. Antennæ twice the length of the body in both sexes, pitchy black, bases of the fourth and sixth joints with pale grey rings. Thorax rather small, tumid on the sides in the middle, constricted near the base; purplish black, the sides each with

three transverse sulphur-coloured lines, one along the front margin extending to the upper surface, and two shorter, near the hind margin; there is also a short line above, in the middle of the fore margin, and a round spot in the middle, near the hind margin. Scutellum purplish. Elytra prominent at the shoulders, then gradually attenuated to near the apex, afterwards more quickly narrowed, apex truncated in a straight line, sutural angle simple, external angle produced into a short and acute tooth; surface clothed with strong erect bristles, each proceeding from a puncture, dark purplish, with a silky gloss; a small oblong spot on each side near the scutellum, and two larger, rounded, on the disk (one before, the other after, the middle) and a transverse spot at the apex sulphur-yellow. Body beneath blackish, clothed with grey pile and with an oblique stripe on each side of the breast, and a row of linear spots on each side of the abdomen, densely ashy tomentose. Legs pitchy red, ringed with ashy; fore tarsi simple in both sexes.

♂ Terminal abdominal segment moderately short, depressed, slightly narrowed towards the apex; both dorsal and ventral plates truncated and slightly emarginated.

♀ Terminal abdominal segment greatly elongated, tubular; ventral plate simply truncated, dorsal lanceolate, longer than the ventral.

This very beautiful little species occurred sparingly at Ega, on slender branches of trees in the forest*.

5. *Colobotheca luctuosa*, Pascoe.

Colobotheca luctuosa, Pascoe, Trans. Ent. Soc. Lond. v., n. s. i. 42.

“*C. nigra*; capite vittis tribus, prothorace quinque, elytris singulis duabus, una humerali altera medio-suturali, ochraceis, his fascia apicali, macula tertia terminali, antennarum articulis quarto sexto-que basi, albis. Long. $4\frac{1}{2}$ lin. Pará.” Pascoe, *loc. cit.* ♂ ♀.

This elegant species is readily distinguishable from all others that I have seen, by its peculiar colouring. The thorax is tumid

* To this section of the genus belongs the following:—

Colobotheca biguttata, n. sp. Parum elongata, convexa, postice a medio elytrorum declivis, grisea. Caput obscure griseum. Antennæ piceæ, articulis basi griseis. Thorax lateribus longe ante basin tuberculatis, deinde angustatus, griseus, dorso fulvo quadrimaculatus. Elytra basi lata, humeris paulo obliquis, imprimis sensim, apices versus citius angustata, apicibus truncatis, angulis suturalibus obtusis exterioribus breviter spinosis; supra punctata, haud setosa, grisea, maculis rotundatis fulvis et altera pone medium majore et discoidali nigra ornata. Pedes rufescentes, tibiis tarsisque nigricantibus, his articulo primo griseo. Maris (?) segmento ultimo abdominali simplici obtuso. Long. $4\frac{1}{2}$ lin. ♂ (?). *Hab.* in Brasilia, a Dom. Jekel sub nomine *C. biguttata* Dej. missa.

on the sides behind the middle, and constricted between that point and the base. The elytra are gradually attenuated from base to apex, and the latter is rather obliquely truncated, with the external angle alone produced into a spine. The scutellum is black, with a yellow spot at its tip. The apex of the elytra is ashy white, and there is also a white dot on the disk not far from the apex. Besides the yellow line on each extending from the base to the middle and the sutural streak, there is also a yellow dot near the suture, a short distance behind the scutellum. The white ring at the base of the sixth antennal joint is obsolete in the female. The body beneath is clothed with grey pile, and has an ochreous-ashy streak of denser pile on each side. The terminal antennal joints are much longer in the male than in the female, and there is but little sexual difference in the form of the terminal abdominal segment.

I met with the species at Ega on the Upper Amazons, and not at Pará, as erroneously recorded by Mr. Pascoe.

6. *Colobothea dioptica*, n. sp.

C. brevis, lata, convexa, brunnea, supra nullomodo setosa, thorace prope basin utrinque tuberculo acuto, deinde subiter angustato; elytris pone medium macula rotundata atro-velutina flavo cincta. Long. $4\frac{1}{2}$ lin. ♂ ♀.

Head black, vertex grey. Antennæ pitchy, bases of the middle joints slightly grey. Thorax widened from the front to near the hind margins, and each side forming at that point an acute prominence, after which it is suddenly narrowed to the base; surface brown, varied with indistinct lighter brown marks. Scutellum dark brown, with a central tawny-ashy spot. Elytra short, broad, and convex, shoulders forming a short and very prominent ridge, the lateral carina proceeding thence being scarcely elevated, and disappearing before the middle of the elytron; apex truncated in a slightly flexuous line, sutural angles rounded off, external angles produced into a short and broad tooth: surface free from setæ, brown, speckled with light tawny brown, and each elytron having, behind the middle, a large round velvety-black spot encircled with yellow. Body beneath black, clothed with grey pile; sides of abdomen spotted with grey; terminal segment shining black. Legs black or reddish, ringed with grey. Fore tarsi simple in both sexes.

♂. Terminal ventral segment deeply notched; dorsal broad and obtuse.

♀. Terminal ventral segment simply truncated; dorsal tapering and obtuse.

On slender dead twigs in the forest; Pará and banks of the Tapajos. Rare.

This species seems to resemble much in colours and shape *Priscilla hypsiomoides*, Thoms. (Systema Ceramb. p. 31); but the character he gives, "brunneo-setosa," does not at all suit, as our insect is one of the few *Colobothea*-forms which are destitute of setæ on the surface of the body.

§ II. Fore tarsi dilated and ciliated in the male.

- a. Thorax tumid on each side behind the middle, or furnished with a tubercle: narrowed at the base.

7. *Colobothea pictilis*, n. sp.

C. elongata, postice modice augustata, grisea; thorace pone medium acute tuberculato, vitta latiore dorsali altera laterali lineolisque duabus utrinque intermediis nigris; elytris apice utrinque bidentatis, fulvo maculatis, fasciis duabus interruptis nigris. Long. $3\frac{1}{2}$ – $4\frac{1}{2}$ lin. ♂ ♀.

Head dusky grey, vertex with two ashy lines, diverging on the occiput. Antennæ black, bases of the joints grey. Thorax widest a little behind the middle, where a conical projection is formed on each side, behind constricted: surface grey, with a central vitta (unequal in width) and a lateral stripe, below the tubercles, black; there are also on each side of the upper surface two fine black lines, sometimes partially united. Scutellum black, with a central ashy spot. Elytra moderately elongated and attenuated, apex sinuate-truncate, sutural angles produced into a short tooth, external ones into an elongate spine; surface grey, sprinkled with tawny patchy spots; each elytron has besides two short angulated lateral fasciæ of a black colour, and more or less distinct indications of a third near the apex. Body beneath clothed with ashy tomentum; abdomen of the female spotted with black. Legs black, ringed with grey: fore tarsi moderately dilated and fringed in both sexes.

♂. Apical ventral segment greatly distorted, its surface forming an angular elevation with an elevated ridge on each side: the concavity thus formed shining black; the dorsal segment is notched in the middle. The middle segments of the abdomen are greatly contracted in the middle.

♀. Apical ventral segment with its terminal angles produced into long spines; dorsal segment broadly notched.

Pará, on branches of dead trees; rare.

8. *Colobothea pulchella*, n. sp.

C. parva, postice sensim attenuata, carneo-grisea; thorace pone medium prominulo angulato, deinde constricto, vitta dorsali (medio constricta) altera laterali lineolisque duabus utrinque intermediis nigris; elytris utrinque apice bidentatis, carneo maculatis, humeris,

fasciis duabus interruptis lituraque subapicali nigris. Long. 4 lin. ♂.

Head pinkish grey, occiput with two stripes and a posterior spot black. Antennæ pitchy black; bases of joints grey, those of sixth, eighth, and tenth joints whiter. Thorax widened behind the middle, and forming there an acute prominence, constricted behind. Surface pinkish grey, with a dorsal vitta (constricted behind the middle), a lateral stripe, and two fine lines on each side black. Scutellum black, with a minute grey spot at the base. Elytra gradually narrowed from base to apex, sinuate-truncate, with the sutural angles produced into a short, the external into a long tooth: surface sparingly clothed with fine setæ, punctured, grey, sprinkled with pinkish patchy spots, a short stripe under each shoulder (continuous with the lateral thoracic stripe), a very short streak proceeding from each angle of the scutellum, a spot on the disk near the base, a short fascia behind the middle, and a curved letter near the apex black. Body beneath grey. Legs grey, ringed with black: fore tarsi in the ♂ moderately dilated and fringed.

♂. Terminal ventral segment strongly elevated towards the tip, the elevation surmounted by a curved ridge, leaving a smooth concave space within; second segment strongly contracted in the middle.

Banks of the Tapajos; one example. This and the preceding species are closely related to a Venezuelan species of much larger size*.

9. *Colobothea obtusa*, n. sp.

C. modice elongata, postice attenuata, fusco-nigra, cinereo maculata; thorace brevi, pone medium parum tumidulo, deinde leviter con-

* *Colobothea lineola* (Chevrol. MS. sec. Dom. Deyrolle).—Elongata, postice sensim attenuata, grisea, fulvo nigroque variegata. Caput nigricans. Antennæ nigricantes articulis basi griseis. Thorax usque ad medium dilatatus, lateribus pone medium valde acute tuberculatis, deinde basin versus sinuato-attenuatus; supra griseus fulvo variegatus, medio vitta postice dilatata, altera laterali lineolisque duabus intermediis nigris. Scutellum postice angustatum, nigrum, macula grisea. Elytra gradatim attenuata, truncata, angulis suturalibus simplicibus, exterioribus valde productis, humeris prominulis parum obliquis; supra breviter setosa, punctata, grisea, punctis nigris maculisque carneo-griseis variegata, utrinque maculis angulatis tribus quarum una pone medium major. Corpus subtus cinereum: abdominis medio et lateribus nigro maculatis; segmento apicali nigro, basi cinereo maculato. Pedes cinerei, nigro annulati: tarsi anticis maris valde dilatatis et ciliatis. Maris segmentum ultimum ventrale simplex, late irregulariter truncatum, angulis haud productis; dorsale obtusum: foeminae segmentum ultimum ventrale angulis dentatis; dorsale magis attenuatum, apice breviter emarginatum. Long. $6\frac{1}{2}$ –8. ♂ ♀. *Hab.* Venezuela.

stricto; elytris apice sinuato-truncatis angulis haud productis. Long. $4\frac{1}{2}$ lin. ♂ ♀.

Head brown, vertex with one, forehead with two ashy stripes. Antennæ clothed with stiff setæ, pitchy black, base of the fifth joint with a white ring; in the male the base of the fourth joint is also ashy. Thorax short and rather rounded on the sides, slightly tumid not far from the base, and then gradually narrowed to the base: surface black, centre with two short lines in front and a longer line behind (pointing between the two short ones) ashy; the sides have each two ashy lines, besides the ashy stripe lying over the fore coxæ. Elytra moderately prominent at the shoulders, apex somewhat narrow and truncated in a slightly incurved line, with the angles not at all prominent; surface punctured and clothed with fine setæ, black, varied with a large number of ashy spots of an oblong or short linear form; apex white. Body beneath greyish. Legs pitchy, clothed with grey pile; femora with a grey central ring; tarsi grey, two terminal joints black: fore tarsi of the male strongly dilated and ciliated.

♂. Terminal ventral segment broadly truncated, angles produced into long spines; dorsal notched.

♀. Terminal ventral segment narrowed towards the tip, angles produced into spines; dorsal also narrowed, notched at the apex.

Eggs, on branches of dead trees. There is a handsome species in collections from Mexico, which much resembles *C. obtusa* in the form of the thorax*.

10. *Colobotheca humerosa*, n. sp.

C. elongata, variegata, thorace tuberculis acutis lateralibus retrorsum spectantibus mox ante basin sitis; elytris humeris antice dilatatis, griseis, carneo maculatis, utrinque fasciis macularibus tribus nigris; pedibus carneo nigro griseoque variis. Long. $4\frac{1}{2}$ –6 lin. ♂ ♀.

Head blackish, forehead with three indistinct yellowish lines, vertex with two similar lines diverging on the occiput, cheeks striped with ashy ochreous. Antennæ pitchy, bases of the fourth

* *Colobotheca leucophæa* (Chevrol. MS. sec. Dom. Deyrolle). Latiuscula, depressa, nigra, cinereo variegata. Caput nigrum, fronte cinereo obscure lineata, vertice vittis duabus cinereis postice divergentibus. Antennæ piceæ, articulis basi cinereis. Thorax brevis, lateribus rotundatis, ante basin tumidis, deinde constrictis; dorso nigro, medio vitta lata (lineola nigra includente) lateribusque maculis tribus cinereis. Scutellum triangulare, nigrum, cinereo marginatum. Elytra latiuscula, depressa, postice modice attenuata, truncata, angulis exterioribus spinosis; nigra, maculis cinereis confluentibus conspersa, relictis fasciis interruptis angulatis duabus nigris, una ante, altera pone medium. Corpus subtus dense cinereo tomentosum. Pedes cinerei, tibiis piceis cinereo annulatis, tarsis cinereis apice nigris. Fœminæ segmentum ultimum abdominale attenuatum; lamina ventrali longe bispinosa. Long. $6\frac{1}{2}$ lin. ♀. Hab. in Mexico.

and sixth joints grey, middle of the terminal joints grey. Thorax at first sight appearing to be gradually narrowed from base to apex; but the base itself is narrowed, and each side has an acute projection, pointed backwards, and nearly touching the humeral callus; surface with thirteen stripes alternately black and tawny, the central (black) stripe with a grey line down its middle. Scutellum black, streaked with grey. Elytra with the shoulders not advanced laterally but vertically and forward, so that the humeral ridge fits into the narrow space between the lateral tubercle and the base of the thorax; the surface is setose, punctured, and grey, with numerous pinkish marks which are chiefly collected round the black fasciæ; the latter are three in number—one, short, before the middle, the second, oblique and angular, behind the middle, and the third, quadrate, at the apex; the extreme apex is bordered with grey or pinkish, and is truncated, with the sutural angle simple, the external produced into a long spine. Body beneath greyish, sides with a stripe of fulvous tomentum, abdomen with the sides spotted in the middle. Legs grey, femora with a pinkish spot on their upper surface; tibiæ ringed with grey and black; tarsi black, with the two basal joints grey; fore tarsi of the male moderately dilated and fringed.

♂. Terminal ventral segment broadly emarginated, angles acute; dorsal narrowed to the tip, broadly notched.

♀. Terminal ventral segment broadly emarginated, with a pencil of stiff hairs proceeding from each angle; dorsal truncated.

Branches of dead trees, forest, Pará. In the colours of the elytra this species resembles *C. velutina*.

To this section of the genus belong also *C. pæcila*, Germar (Ins. Nov. p. 488), *C. subcincta*, Castelnau (Anim. Artic. ii. p. 491), *C. strigosa*, Mannerheim *, and *C. vidua* † (Chevrol. MS.);

* *C. strigosa* (Mannh. sec. Dom. Deyrolle). Elongata, postice paulo attenuata. Caput et antennæ rufescentia, hæ articulis basi pallidioribus. Thorax ante basin tuberculo conico instructus, deinde parum angustatus, dorso brunneo vittis quinque lateribusque nigris. Scutellum nigrum, macula grisea. Elytra brunnea, cinereo fulvoque varia, macula obliqua angulata ante medium, fascia valde undulata pone medium liturisque angulatis prope apicem nigris; apicibus sinuato-truncatis, angulis suturalibus paulo, exterioribus valde productis. Corpus subtus ochraceum, abdomine nigro maculato. Pedes rufescentes, cinereo annulati. Long. 7 lin. ♀. *Hab.* in Brazil.

† *C. vidua*. Minor, nigra, cinereo maculata. Caput nigrum, vertice lineolis duabus divergentibus cinereis. Antennæ nigrae, articulis basi griseis. Thorax angustior, lateribus pone medium tuberculo parvo armatis; niger, dorso vittis duabus maculam includentibus lineolaque laterali cinereis. Elytra nigra, cinereo sparsim maculata, apice truncata, angulis exterioribus productis. Corpus subtus cinereum. Pedes nigri, cinereo annulati. Long. 4½ lin. ♀. *Hab.* in Mexico.

the last mentioned from Mexico, the other two from Rio Janeiro. *C. Schmidtii* * of French collections (Brazil) from the very slight, if any, narrowing of the thorax near the base, seems to stand on the confines of subsections *a* and *b*.

XXVI.—*On the Nomenclature of the Foraminifera.* By Messrs. W. K. PARKER, F.Z.S., T. R. JONES, F.G.S., and H. B. BRADY, F.L.S., F.G.S.

Part XI.—*The Species enumerated by Batsch in 1791.*

IN order of priority the Foraminifera described and figured by Batsch should have been noticed next to those enumerated by Linnæus and Gmelin; but we had then had no opportunity of seeing his book, or otherwise of identifying the species named by him. The work, a copy of which we have been fortunate enough to secure, appears to be scarce, and consists mainly of a series of six beautiful and characteristic quarto copper-plates of minute sea-shells. The letterpress is confined to four quarto pages, one of which is occupied by the title. We propose to give a translation of the descriptions of the species, and to append to each such observations as appear necessary. Unlike the drawings given by nearly all the other earlier naturalists, those in Batsch's work leave no room for doubt as to the species for which they are intended; the specimens have been so carefully selected, and the figures are so beautifully drawn and so well engraved, that identification becomes an easy process. In addition to this, our author shows great judgment in putting together the varietal forms of the *Nodosaria* group, distinguishing them from the porcellaneous-shelled *Peneroplides*. The whole of the figures are of Foraminifera (sixteen "*species*"); and of each form several drawings are given, together with minute outlines of the natural size. It is greatly to be regretted that we have no record of the locality whence the material containing the specimens figured was obtained, as one at least of the varietal forms of *Nodosaria* (No. III., *N. murex*) has not, so far as we know, been noticed by subsequent observers.

* *C. Schmidtii*. Elongata, postice attenuata. Caput obscurum, vertice cinereo macula trigona nigra. Antennæ nigrae, articulis basi griseis. Thorax ante basin tuberculo parvo, deinde vix angustatus; dorso griseus, vittis quinque nigris, mediana latiore lineolam griseam includente. Elytra grisea, nigro punctata, maculis confluentibus ochraceo-cinereis conspersa, maculis majoribus vel fasciis tribus nigris, una (interdum obsoleta) ante medium, altera majore angulata pone medium, tertiaque prope apicem; apicibus sinuato-truncatis, angulis suturalibus prominulis, exterioribus productis. Pedes picei, cinereo annulati. Fœminæ segmentum ultimum dorsale attenuatum bifidum; maris emarginatum. Long. $7\frac{1}{2}$ lin. ♂ ♀. *Hab.* in Rio Janeiro, a Rev. Hamlet Clark lecta.

The work is entitled 'Sechs Kupfertafeln mit Conchylien des Seesandes, gezeichnet und gestochen von A. J. G. C. Batsch. Pränumérations-Preis, schwarz, 12 gr., illuminirt 1 Rthlr. Jena, in Commission der academischen Buchhandlung, 1791.' There is no preface to the work, a short note, of which the following is a translation, serving as introduction; after this, a simple description of the species to which each figure is referred is given. In addition to the Latin generic and specific names, each form has a vernacular designation appended, which is mostly a translation of the Latin into German.

(Translation.) "A short description of the plates, which are of many-chambered shells, either quite straight or partially curved."

I. *Nautilus* (*Orthoceras*) *costatus*. The Ribbed Sea-staff. Pl. 1. fig. 1 *a*–1 *g*. [*Nodosarina* (*Marginulina*) *Raphanus*, Linn. sp.]

(Trans.) "The chambers or joints are round, bullet-shaped, and separated from one another, and are bound by strong ribs, which extend without interruption over the whole of the shell, and have for the most part smooth edges. The forms differ both in contour and colour, which here, less than in other natural objects, determine the general character. Fig. 1 is ground down to show the construction of the interior. In Plates 1 and 2 the small horizontal lines show the natural sizes."

Seven figures in all are given of this form, one of them being evidently a careful representation of a shell with a portion of the surface ground off, so as to show the interior. They represent the strongly ribbed and frequently Marginuline form of *Nodosarina*, to which the specific name *Raphanus* had previously been given by Linnæus. Amongst the specimens here figured there is a varying degree of obliquity of growth in the earlier chambers, and excentricity of terminal aperture. Whilst the figures generally are *Marginulinæ*, fig. 1 *a* is only removed from *Nodosaria* by its *slightly* excentric aperture; and the fragment fig. 1 *e* is a true *Nodosaria* without any Marginuline curvature.

II. *Nautilus* (*O.*) *comatus*. The Haired Sea-staff. Pl. 1. figs. 2 *a*–2 *d*. [Figs. 2 *a*, 2 *b*. *Nodosaria comata*, Batsch; figs. 2 *c*, 2 *d*. *Glandulina glans*, D'Orb.]

(Trans.) "The cylindrical joints run more together, and the whole is covered with riblets, which are continuous, except over the end portions of the terminal chamber. Probably fig. 7 *b* (on plate 3) is simply a variety. Both specimens are ground away."

The figures referred to belong to two somewhat different varietal forms of *Nodosarina*. Figs. 2 *a* and 2 *b* represent a smallish specimen of *Nodosaria Raphanus* (the earliest chamber

imperfect), in which delicate riblets take the place of costæ as ornamentation. These riblets do not run the entire length of the shell, and become, on the large terminal chamber, fine hair-like markings. The chambers are also less separated at the sutures than in *N. Raphanus*. Figs. 2 *c* and 2 *d* represent the one an outside view, the other a section, of a shortened, more conical form of *Nodosarina*, with a similar striate or hairy ornament running over it. Both contour and surface-marking are accurately given in D'Orbigny's 'Modèle' No. 51 (*Nodosaria* (*Glandulina*) *glans*).

III. *Nautilus* (O.) *Murex*. The Warty Sea-staff. Pl. 2. figs. 3 *a*, 3 *b*.
[*Nodosaria Murex*, Batsch.]

(*Trans.*) "The chambers are round and bullet-shaped, covered with warts, and separated by smooth belts. The specimen ground down is curved."

So far as we know, this peculiar form has not been figured by any other author, neither have we ever seen specimens of the shell, though we have no reason to doubt the existence of such a variety.

IV. *Nautilus* (O.) *scalaris*. The Yoked Sea-staff. Pl. 2. figs. 4 *a*, *b*.
[*Nodosaria scalaris*, Batsch.]

(*Trans.*) "The round, bullet-shaped chambers are provided with delicate ribs, running perpendicularly and joining where the chambers meet."

D'Orbigny subsequently figured the same form as *Nodosaria longicauda*. The figure in Professor Williamson's Monograph (Rec. For. Gt. Br. pl. 2. fig. 38), where it is given as *N. radícula*, Mont., might almost have been taken from the same specimen as that drawn by our author.

V. *Nautilus* (O.) *obliquatus*. The Slant-grooved Sea-staff.
Pl. 2. figs. 5 *a*–5 *d*. [*Nodosaria obliquata*, Batsch.]

(*Trans.*) "This very much elongated shell has longish chambers, which run almost into one another; and it is provided with string-like ribs, which run in a not quite straight direction down the shell."

Figures 5 *a*, *b*, & *d* show an even-margined, straight *Nodosarian*, with oblique parallel ribs. Figure 5 *c* is a portion of a somewhat curved specimen with similar ornamentation, showing, by its association with the other, a correct appreciation of the valuelessness of mere curvature as a specific character. The same form has been figured by Reuss (*Zeitschr. Deutsch. Geol. Gesel.* vol. iii. pl. 3. fig. 12) as *Dentalina obliquestriata*.

VI. *Nautilus* (O.) *vertebralis*. The Vertebral Sea-staff. Pl. 2.
figs. 6 *a*, 6 *b*. [*Nodosaria Fascia*, Linn.]

(*Trans.*) "A prolonged almost unjointed shell, which has a few

continuous somewhat waved ribs. The partition-walls are broad and transparent."

These are interesting figures of one of the thick-ribbed limbate *Nodosaria*, several varieties of which are found in the Adriatic. The distinction between the first, or essential, shell and the thickened, or supplemental, portions is carefully rendered. All the straight forms with longitudinal costæ and broad transverse bands of clear shell-substance may be included under Linné's *Nodosaria Fascia*. (For further remarks on these, see Ann. & Mag. Nat. Hist. ser. 3. vol. xii. pp. 432, 433.)

VII. *Nautilus* (O.) *vaginæformis*. The Sheath-shaped Sea-staff.

Pl. 3. figs. 7 *a*-7 *d*. [Fig. 7 *a*. *Lingulina carinata*, D'Orb.; fig. 7 *b*, either *Lingulina* or *Glandulina*, longitudinal section; fig. 7 *c*, *d*. *Marginulina*, sp. ?]

(Trans.) "The shell is broad and flat, with scarcely separated chambers, the broad and blunt under surfaces* of which reach far into succeeding chambers."

This is a mixed group of somewhat indefinite forms, and we do not see that it ought to affect the nomenclature of already well-recognized subtypical species, whilst such uncertainty exists. Although the drawings are made with the same care as the others, we cannot recognize in fig. 7 *c*, or the sectional diagram, fig. 7 *d*, any form of *Marginulina* with which we are familiar. It appears as though it might have a rough or subarenaceous shell. We shall run the least risk of error or confusion in leaving these figures without further comment.

VIII. *Nautilus* (O.) *leguminiiformis*. The Pod-shaped Sea-staff.

Pl. 3. figs. 8 *a*, 8 *b*. [Fig. 8 *a*. *Vaginulina leguminiiformis*, Batsch; fig. 8 *b*. *Dentalina communis*, D'Orb.]

(Trans.) "The smooth, almost coincident joints of this elongated shell are nearly cylindrical, and fit into each other like sheaths."

Fig. 8 *a* does not so well answer to the description given as the succeeding figure (8 *b*), it being one of the flattened or Vaginuline group of *Dentalinæ*, a form given by D'Orbigny, in his 'Voyage dans l'Amér. Mérid.' as *Marginulina Webbiana* (pl. 5. fig. 17). The trivial name *leguminiiformis*, however, will take precedence of that given by D'Orbigny. Fig. 8 *b* is the subcylindrical tapering form known as *Dentalina communis*, D'Orb.

IX. *Nautilus* (O.) *globifer*. The Button-bearing Sea-staff.

Pl. 3. figs. 9 *a*-9 *c*. [*Nodosaria globifera*, Batsch.]

(Trans.) "The chambers are elongated and somewhat distinct; only

* The upper ends or stolon-passages.

the last [properly the first], the lowest in the drawing, is bullet-shaped. At the top it is button-shaped."

This is a straight *Nodosarian*, with much-elongated egg-shaped chambers. Setting aside the fact of the first chamber in two of the specimens figured being somewhat globular (whence Batsch's appellation), as a matter of little moment, they accurately represent the form figured by Soldani (*Testac. ac Zooph.* vol. iv. pl. 10. figs. H-M), and named by D'Orbigny *Nodosaria ovicula* (*Ann. des Sc. Nat.* vol. vii. p. 252).

X. *Nautilus* (O.) *Radicula*. The Knotted Sea-staff. Pl. 3. figs. 10 a, 10 b. [*Nodosaria limbata*, D'Orb.]

(*Trans.*) "The chambers are bullet-shaped, very distinct, and unusually strong."

The figures given are of the round-chambered, clear-shelled *Nodosaria*, free from surface-ornamentation, excepting belts of clear shell-substance at the union of the chambers. The same form is figured by D'Orbigny (*Craie blanche du Bassin de Paris*, pl. 1. fig. 1) under the name of *Nodosaria limbata*; and members of the group of which this may be considered the best central form have received many names at the hands of other authors. The specific name *radicula* had previously been employed by Linnæus for another and distinct form of *Nodosaria*; so that it is not admissible in the present case.

XI. *Nautilus* (O.) *conico-articulatus*. The Cone-chambered Sea-staff. Pl. 3. fig. 11. [*Articulina conico-articulata*, Batsch.]

(*Trans.*) "The chambers are shaped like inverted cones, and the walls are folded into oblique furrows. It was quite impossible to grind away this shell, as it was too brittle."

The feeble forms of *Vertebralina*, taking a much-elongated, narrow, subcylindrical contour, received from D'Orbigny the generic name *Articulina*. Though only embracing varieties of the type *Vertebralina striata*, we may, as a matter of convenience, keep the term. Fig. 11 represents the form indicated in the 'Modèles' (No. 22), and there named *Articulina nitida*.

XII. *Nautilus* (O.) *margaritiferus*. The Pearl-bearing Sea-staff. Pl. IV. figs. 12 a-12 c. [*Vaginulina margaritifera*, Batsch.]

(*Trans.*) "This strong, elongated, and almost unjointed shell is flattened, and has two sharp edges, and has in the middle high and projecting partition-walls, the feeble continuations of which can be seen at one edge."

A bold thick-shelled *Vaginulina*, with transverse ribs of clear shell-substance overlying the partition-walls between the chambers. A similar, but still more lmbate, form has been named by D'Orbigny y *Vaginulina elegans* Modèles, No. 54).

XIII. *Nautilus* (O.) *Pennatula*. The Sea-feather Sea-staff. Pl. 4. figs. 13 *a*–13 *c*. [*Grammostomum Pennatula*, Batsch.]

(*Trans.*) “The partition-walls, which at the beginning of its growth are strangely crowded together, make at the upper* end of the shell an altered feather-like portion. Figure *e* represents one of these parts alone.”

We have here five beautiful figures of the wide, flat Textularian form which commonly becomes uniserial in its mature growth. The subgeneric term *Grammostomum* is employed for this group. D’Orbigny (Modèles, No. 59) represents the same varietal form under the name *Vulvulina capreolus*.

XIV. *Nautilus* (O.) *Harpa*. The Harp-shaped Flat Sea-staff. Pl. 5. figs. 14 *a*–14 *e*. [Fig. 14 *a*. *Frondicularia complanata*, Defrance (fragment); fig. 14 *b, c*. *Flabellina Harpa*, Batsch; fig. 14 *d, e*. *Planularia Auris*, Fichtel & Moll.]

(*Trans.*) “The shell is quite flat, bright, and smooth. The partition-walls run obliquely, are parallel, and shine through the otherwise opaque shell. In this and in figure 13 may be clearly seen how little nature has made the evident character depend upon either form or colour.”

The five fine drawings on this plate are a somewhat mixed lot of closely allied forms. It would scarcely be right to supplant Defrance’s name for the subtypical *Frondicularia* on the authority of a figure of a fragment of shell confused with other specimens. Figs. *b* and *c* constitute the first notice we have of the Flabelline character of growth; and Batsch’s trivial name falls naturally into its place for the smooth partially costate forms. The other two figures represent *Planularia Auris*, F. & M.

XV. *Nautilus* (*Lituus*) *arietinus*. The Ram’s-horn Bishop-staff. Pl. 6. figs. 15 *a*–15 *f*. [Fig. 15 *a, b*. *Peneroplis pertusus*, Forskål; fig. 15 *c*. *Peneroplis pertusus*, var. *arietinus*, Batsch; fig. 15 *d, e, f*. *Spirolina Hemprichii*, Ehrenberg.]

(*Trans.*) “In all the different forms two characters remain quite evident, namely, the strong shell and its numerous folds or wrinkles. It is also much coiled.”

The varieties of *Peneroplis* of which this plate consists are, with much judgment, separated generically from the forms preceding them, which, as we have shown, belong almost entirely to the Nodosarian group. The term *Lituus* used by our author had previously been employed by Gmelin as a specific name for one of the varieties of the genus; consequently it cannot be brought forward to displace the well-known and convenient generic appellation originated by Montfort, *Peneroplis*.

* Really the lower or first-formed portion.

These six figures, associated by Batsch as one species, together with the two which follow (16 *a*, 16 *b*), are varieties of the type *Peneroplis pertusus*, differing amongst themselves chiefly in the comparative length and breadth of the chambers and the extent to which they are coiled. Whilst insisting on the specific unity of the whole of the variations of form to which the type is subject, it is, zoologically, a convenience to recognize certain intermediate stages as constituting varieties worthy of distinct name. Thus the extremely dilated, flat, bonnet-shaped condition takes the subspecific name *P. planatus*, F. & M.; the moderately dilate, central-typical form is *P. pertusus*, Forskål; and one of the figures now under notice (15 *c*) might worthily take its place as a variety, with Batsch's name *P. arietinus*. In figs. *a*, *b*, and *c* the shape of the shell is determined by the excessively wide, flat development of the later chambers. In figs. *d*, *e*, and *f* the tendency is somewhat different, the later chambers leaving the nautiloid portion in a straight cylindrical line; and this tendency reaches its fullest development in the last two figures on the plate (16 *a*, *b*). These "Spiroline" forms were recognized by Lamarck and others, but confused with isomorphous varieties of *Valvulina* and *Lituola*; removing these, however, the long crozier-like *Peneroplides* may retain the term *Spirolina* (used subgenerically, for the sake of convenience only, not zoologically). The term *Coscinospira* was adopted by Ehrenberg for a short, stoutish, Lituata or Spiroline form, such a one as figs. 15 *d*, *e*, *f*.

The wide variation in character presented by specimens of the type now under notice has caused much confusion in the nomenclature; and it will not be out of place here to point out some of the forms of *Peneroplis* referred to and named by the earlier writers, together with the view we take of their value.

- 1775. *Nautilus pertusus*, Forskål, = *Peneroplis pertusus*, Forsk. Type*.
- 1781. *Nautilus rectus*, Spengler, = a mixed lot (*Peneroplis* and *Articulina*).
- 1788. *Nautilus Lituus*, Gmelin, = *Peneroplis* (*Spirolina*) *Lituus*, Gm.
- 1791. *Nautilus* (*Lituus*) *arietinus*, Batsch, = *Peneroplis arietinus*.
- 1791. *Nautilus* (*Lituus*) *acicularis*, Batsch, = *Peneroplis* (*Spirolina*) *Lituus* (Gm.).
- 1803. *Nautilus planatus*, Fichtel & Moll, = *Peneroplis planatus*, F. & M.
- 1804. *Spirolina depressa*, Lamarck, = *Peneroplis pertusus*, Forsk.
- 1804. *Spirolina cylindracea*, Lamarck, = *Peneroplis* (*Spirolina*) *Lituus*, Gm.
- 1808. *Peneroplis lanatus*, Montfort, = *Peneroplis planatus*, F. & M.
- 1826. *Dendritina arbuscula*, D'Orbigny, = *Peneroplis* (*Dendritina*) *arbuscula*, D'Orb.
- 1839. *Coscinospira Hemprichii*, Ehrenberg, = *Peneroplis* (*Spirolina*) *Hemprichii*, Ehr.

 Varieties of *P. pertusus*.

* See Ann. Nat. Hist. ser. 3. vol. viii. p. 235. Forskål describes this species, and recognizes its marked variation of form, in 'Descript. Anim.

XVI. *Nautilus* (L.) *acicularis*. The Needle-shaped Bishop-staff.
Pl. 6. figs. 16 a, 16 b. [*Spirolina Lituus*, Gmelin.]

(*Trans.*) "This is a linear or awl-shaped shell, extraordinarily delicate, with projecting riblets. The curvature of the top forms a small head, somewhat in the form of a knot."

As we have above stated, this is the very slender *Spiroline* form of *Peneroplis* described by Gmelin as *Nautilus Lituus* (see Ann. Nat. Hist. ser. 3. vol. iii. p. 481).

The following is a summary of the forms figured by Batsch :—

Fig.		
1.	<i>Marginulina Raphanus</i> , Linn.	} Type, <i>Nodosarina Raphanus</i> , Linn.
2 a, b.	<i>Nodosaria comata</i> , Batsch.	
2 c, d.	<i>Glandulina glans</i> , D'Orb.	
3.	<i>Nodosaria Murex</i> , Batsch (new).	
4.	<i>Nodosaria scalaris</i> , Batsch.	
5.	<i>Nodosaria obliquata</i> , Batsch.	
6.	<i>Nodosaria Fascia</i> , Linn.	
7 a.	<i>Lingulina carinata</i> , D'Orb.	
8 a.	<i>Vaginulina leguminiformis</i> , Batsch.	
8 b.	<i>Dentalina communis</i> , D'Orb.	
9.	<i>Nodosaria globifera</i> , Batsch.	
10.	<i>Nodosaria limbata</i> , D'Orb.	
12.	<i>Vaginulina margaritifera</i> , Batsch.	
14 a.	<i>Frondicularia complanata</i> , DeFrance.	
14 b, c.	<i>Flabellina Harpa</i> , Batsch.	
14 d, e.	<i>Planularia Auris</i> , F. & M.	
11.	<i>Articulina conico-articulata</i> , Batsch.	} Type, <i>Vertebralina striata</i> , D'Orb.
13.	<i>Grammostomum Pennatula</i> , Batsch.	
15 a, b.	<i>Peneroplis pertusus</i> , Forskål.	} Type, <i>Peneroplis pertusus</i> , Forskål.
15 c.	<i>Peneroplis arietinus</i> , Batsch.	
15 d, e, f.	<i>Spirolina Hemprichii</i> , Ehrenberg.	
16.	<i>Spirolina Lituus</i> , Gmelin.	

MISCELLANEOUS.

Note to a Paper on Plesiosaurus macropterus.

To the Editors of the Annals of Natural History.

GENTLEMEN,—The proof of the paper on a "New Lias Plesiosaur" (in the 'Annals' for January) reached me under circumstances which precluded revision. Hence there are many omissions, three of which I wish to supply at once.

1. *Plesiosaurus homalospondylus*, to the best of my knowledge,

Itin. Orient.' (1775, p. 125), as follows:—"Having compressed whorls, transversely sulcated, and marked with slight longitudinal striæ; the aperture perforated with pores. Colour snow-white. Whorls straight at the base [top], often dilated, sometimes linear; apex [earliest part] convolutely spiral."

was so named by Prof. Owen. It is quoted in the 'Palæontology' as a species with forty anterior vertebræ supporting ribs on the centra; and as the specimen at York appeared to differ specifically, I merely wished to point the fact out, and not to transfer the type of the species to the York specimen.

2. To the statement that the head of *Plesiosaurus Etheridgii* is " $\frac{1}{12}$ th of the body" should have been added a note that this was on the authority of an abstract in the 'Annals of Natural History' ser. 3. vol. i. p. 158, Prof. Huxley's paper (Quart. Journ. Geol. Soc. p. 281, 1858) gives it as less than $\frac{1}{13}$ th of the body.

3. Prof. Owen had recognized, many years ago, the distinct character of the Plesiosaur described, and suggested for it the name (*grandipinnis*, which for uniformity was rendered into) *macropterus*. Had I been aware at the time that a monograph of Lias Plesiosaurs may shortly be expected from Prof. Owen, I should not have published my own brief notes.

I am, Gentlemen,

Sidney College, Cambridge.

Very truly yours,

HARRY SEELEY.

New British Lichens. By the Rev. W. A. LEIGHTON.

In October last, I discovered on wood-palings at Stableford, near Bridgenorth, Shropshire, *Lecidea tantilla*, Nyl., growing in plenty with *Lecanora varia*, var. *conizæa*, Ach., and *Lecidea ostreata*, Ach. In January 1865 I also found on railings, near Shrewsbury, in great plenty and in a state of beautiful perfection, a lichen belonging to the genus *Odontotrema*, Nyl., a genus new to Britain, which on microscopically comparing with a specimen of *O. minus*, Nyl., received from Dr. Nylander himself, I found to have sporidia double the size of those in that plant, and triseptate, and consequently to be a new species. I immediately sent a specimen of my plant to Dr. Nylander; and he replied (Jan. 5, 1865), "Votre *Odontotrema* est nouveau;" and he names it *O. longius*, Nyl., remarking, "mais presque une variété de l'*O. minus*." Of these lichens I hope shortly to give further description and illustration in the 'Annals,' and dried specimens in the 13th fasc. of my 'Lich. Brit. Exs.' now in preparation.

It may be also well to note that Dr. Nylander says, in a letter to me, dated Feb. 11, 1865, "Le *Thelocarpon Laureri* [see 'Annals,' Dec. 1864] est très-répendu, sans doute; je l'ai en excellent état sur du bois pourri de l'intérieur de la Finlande."

Shrewsbury, Feb. 16, 1864.

On the Inflorescence and Flowers of the Cruciferae.

By D. A. GODRON.

The plants with a racemose mode of inflorescence usually present at the base of each peduncle a more or less developed bract, which is generally rudimentary, although very constant. In the Cruciferae, however, these bracts are generally wanting. The author endeavours to prove that they exist in the original plan of the Cruciferae, and supports this opinion by the rather numerous examples of bracts

which make their appearance occasionally upon various parts of the axis of inflorescence, but most frequently at its base. These bracts, in many species, are like leaves in producing decurrent projecting lines, preserving the characters which distinguish the margins of bracts and leaves. Moreover, when the bracts disappear, they leave traces of their existence in those decurrent lines which render the axis of inflorescence angular.

The author investigates the cause of the habitual abortion of the bracts, and thinks he has discovered it in the mode of successive development of the leaves and flowers. The stem, in commencing its evolution, is furnished with contiguous leaves; and at the extremity of the cauline axis the rudiments of flowers are produced, which form, not a raceme, but a simple, concave, closely packed corymb, closely enveloped and exceeded by a great number of erect leaves, closely pressed together, which, by their elasticity, present more or less resistance to the expansion of the flowers. The latter are, in fact, developed successively upon a sort of narrow terminal plateau, in which the youngest flowers, placed in the centre, push the older ones from within outwards against the enveloping leaves. It will hence be understood that the bracts, not finding sufficient space for their development, disappear from the midst of the flowers by compression, which is so powerful an abortive agent.

The author also calls attention to the fact that the peduncles are depressed from in front backwards, and the more in proportion as the raceme is fuller and presents a greater resemblance to a corymb, and that the flower-buds themselves present the same fact more or less distinctly, and in the same direction as the peduncles. The anterior and posterior sepals are narrower than the lateral ones, and are never inflated at the base, as if they had been hindered in their development. The petals, having an oblique direction in relation to the sepals, escape in consequence the modifying action of which the effects have just been described, except, perhaps, in some genera, such as *Iberis*, in which the dissimilarity of the organs seems to be due to the arrangement of the raceme in its earliest stages of development.

In the theory of an andrœcium with a double whorl, accepted by the author, the two stamens of the exterior whorl, which are opposite to the upper and lower sepals, are regarded as being habitually aborted, and, in his opinion, in consequence of the same cause which likewise frequently induces the complete abortion of the gland upon which each of these stamens is inserted when they occasionally make their appearance, or allows it to persist, or shortens and deforms it more or less, according to the degree in which its action is exerted.

He thinks also that if the long stamina, originally distant from each other, subsequently become approximated (usually in two groups), this must be attributed to an oblique pressure, simultaneously taking place in two convergent directions, exerted by the flower-buds upon each other.

Most authors regard the fruit of the Cruciferae as formed of two carpellary leaves, which seems to be indicated by the number of cells and that of the stigmata. The author, however, following the example

of Kunth and Lindley, admits here the quaternary type which in the primitive plan of the flower would be general in all the floral whorls. He supports this opinion by new examples, added to those already known, of siliques with four valves, and also by teratological facts, namely, the transformation, in certain proliferous flowers of this family, of the four carpellary leaves into four sepals having rudiments of ovules. He thus proves, in this case, another abortion, taking place in the antero-posterior direction.

From the facts established in his memoir he deduces the following conclusions :—

1. The quaternary type, with two series of stamina on the andrœcium, constitutes the primitive symmetry of the Cruciferae.

2. The absence of bracts, the greater or less flattening of the peduncles, the more or less depressed form of the flower-bud, the slight irregularity of the calyx, the absence of two stamina in the outer whorl of the andrœcium, and often of the two glands upon which they should have been inserted, and, lastly, the abortion of two carpellary leaves are induced by a pressure exerted from within outwards upon the flowers and bracts of the Cruciferae.

3. This pressure is due to the accumulation of the flowers, which are developed in great numbers at the apex of the inflorescence (which is then corymbiform) and mutually hinder each other in their evolution, but also to the resistance presented to this expansion by the closely approximated leaves surrounding the inflorescence at its origin.—*Comptes Rendus*, December 19, 1864, p. 1041.

On Ancient Human Races of Belgium, contemporaneous with the Reindeer and the Beaver. By Professor Van BENEDEN.

Close to the Cavern of Nutons, which is situated in the valley of the Lesse, in an excavation which can hardly be called a cave, we have found human bones in abundance ; and we have stopped digging until the 26th December, in order to give an opportunity to those who may be interested in the matter, of seeing with their own eyes (I will not say fossil men, as the word is too elastic, but) skeletons which have been entombed there by the waters before or during a great cataclysm. This grotto is situated 40 metres above the present level of the Lesse. The skeletons are found in the following conditions :—All the bones are scattered, the long bones always placed longitudinally, and a perfect human cranium beneath a large stone which still adheres to the wall by stalagmites. This cranium is half filled with stones, which are scarcely smaller than the occipital foramen through which they have passed. In front of the cranium there was a scapula, some clavicles, ribs, long bones, and vertebræ of children, young people, and adults. A cervical vertebra was pressed over the coracoid apophysis of the scapula with such force that the ring has been broken, and it cannot be detached without violence. Bones were found *wedged in* between stones in such a manner that there was absolutely no space between them and the sides of the stones. Water alone could have produced such an effect. In the

midst of some large stones there was another complete cranium, but of this the parietal bone is fractured. We commenced with the frontal bone of a child. We have also half a dozen lower jaws, and nearly all the bones, even to the sternum, the sacrum, the bones of the tarsus and carpus, the phalanges and separate teeth. The bones are completely destroyed or fall to powder where the water penetrates during winter—that is to say, where it soaks through the walls. The other bones, which are in a dry state, are in a perfect state of preservation.

These human bones occur side by side with bones of a Bear (not *Ursus spelæus*, but more nearly allied to the existing species), of the Ox, Horse, Reindeer, Beaver, Glutton, Goat (it might be taken for our domestic Goat), and several Carnivora, a mass of Birds, Fishes, (Trout and Pike), Snails (*Helix pomatia*, *H. lapicida*, *H. arbustorum*, and *H. cellaria*), and the *Unio batava*, which, like the *Helices*, still exists in the neighbourhood. With these bones there occur flint implements of the most primitive form, fragments of charcoal, calcined bones, and fragments of a very coarse pottery. We have also found some worked antlers of the Reindeer, but no appearance of designs.

There has been no disturbance of the soil, and there is no external communication except in front; the earth and stones which fill the grotto are placed in a plane slightly inclined towards the bottom, and it is evident to all those who see these objects in their place that the human bones were deposited at the same time with those of the animals.

After some observations on the progress of the excavations, and the means adopted for preventing this interesting deposit from being tampered with, Professor Van Beneden proceeds as follows:—"I send you sketches of the two crania above mentioned, to serve until I can send a photograph of them, and afterwards casts. You will see that No. 2 is as brachycephalic and prognathous as it can be; No. 1 is orthognathous, and the cranium is more elongated behind. The outlines present no less difference. The prognathous skull No. 2 is truncated in front; the other is regularly arched, and exhibits the parietal swellings more towards the front. I may remark also that the cranium No. 1 is by far the best-preserved, its bones being as hard as if it had been buried but a little while, whilst the bony substance of No. 2 is very friable. They were nevertheless side by side. It is the well-preserved cranium (No. 1) that was half filled with unrolled pebbles and fragments of charcoal, with a metacarpal bone and some fragments of bones. What interpretation is to be given of these facts? Has No. 1 succeeded No. 2, or did they live together? You will remark that the prognathous skull has a finer cranial capacity than the other."

In communicating to the Academy of Sciences the above extracts from Professor Van Beneden's letters to him, M. de Quatrefages remarks that the prognathism of No. 2 seems exactly to correspond with a fact of the same nature, exhibited by an upper jaw from a cave of the Aveyron, presented to the Anthropological Society by

M. Pruner-Bey. The latter and M. Gratiolet showed that the prognathism of this isolated jaw did not indicate any real resemblance to the Quadrumanous type. The cranium discovered by M. Van Beneden fully confirms this view; for in this the cerebral development is perfectly Human, and the frontal region in particular presents a remarkable extent. On the other hand, the well-marked brachycephalism of this cranium forbids all approximation to the negro type.—*Comptes Rendus*, December 26, 1864, p. 1087.

Note on the Metamorphoses of Marine Crustacea.

By M. Z. GERBE.

After referring to the researches of M. Coste and himself, which led them to the conclusion that the larvæ of the *Palinuri* are identical with the Crustacea described by naturalists as forming the genus *Phyllosoma*, the author states that, as several zoologists are still doubtful of the truth of these results, he gives a description of the observed facts, in proof of the opinion above mentioned.

The larva of the *Palinurus* of our seas manifests those general characters which have been described in the exotic species of *Phyllosoma*—as, for example, the absence of branchiæ, and the flattened, membranous, diaphanous body, divided into two bucklers, one of which, of larger size and rounded form, constitutes the head, and supports in front four antennæ and two pedunculated eyes, whilst the other, smaller one, terminated posteriorly by a short and slender abdomen, bears the footjaws and true feet, furnished with ciliated appendages.

This larva does not, indeed, correspond completely with the characters of the genus *Phyllosoma*: thus it presents no trace of the false feet which are attached to the abdominal segments of *Phyllosoma*; the last of these segments is simple, instead of being terminated by a fin composed of five laminæ; and, lastly, it only exhibits two pairs of footjaws and three pairs of true feet.

Hence it would at first appear that the embryo of *Palinurus vulgaris* is not a *Phyllosoma*, as it does not present all the characters of that genus. But these are in reality only transitory differences, which will be successively effaced in the course of the first four or five changes of skin. Even at this period, some of the organs which these moults are to bring to light are represented by excessively rudimentary buds, with corresponding nervous ganglia and divisions of the sternal artery; the first two footjaws and the last two pairs of true feet are in this condition.

On witnessing the hatching of the marine Crustacea, and following their development, we find that *all make their appearance in a larval form, and that, immediately after their birth, all of them undergo a first moult*. They detach themselves from the epidermal envelope in which their ovarian development has been effected; and when they are entirely freed from it, organs which were previously invaginated, like the pedunculated eyes of the Snails, become everted. Of this sort are the spines which arm the cephalothorax of most of them (especially the larvæ of the *Zoëa*-form), the last joint of the footjaws

and true feet, the ciliated fringes of the provisional natatory organs, and the spines, hairs, or filaments which terminate the antennæ and the last segment of the abdomen. But *in no species*, not even in the Lobsters, which, of all Crustacea, are hatched in the most perfect condition, *does this first metamorphosis cause the appearance of the lateral laminae of the caudal fin and the false feet*. These organs remain latent, the latter until the second moult, the former until the third. The lateral laminae of the tail, when they first become visible, are in the form of very small oval disks, and the false feet are represented by short, bifid, smooth, rounded appendages; neither of them acquire the characters which they present in the perfect animal until the fourth moult.

This is the case with the other organs which are incomplete, rudimentary, or deficient at the moment of exclusion; at each moult some become complete, others acquire more and more their normal form, whilst others make their first appearance, to arrive subsequently at their final perfection*.

In conclusion, the author expresses himself as follows:—"The facts which I have just detailed very briefly, facts which I have seen constantly and invariably produced, justify us in thinking that the embryos of *Palinurus vulgaris*, being subjected to the same metamorphoses as the larvæ of the other marine Crustacea, must, like them, acquire those organs of which they are destitute at birth, after several moults. The investigations which I am engaged in will, I hope, soon enable me to bring evidence in support of this assertion, and at the same time to demonstrate that if the *Phyllosomata* of authors present more perfect characters than the larva which forms the subject of these observations, it is because these *Phyllosomata* have already undergone several metamorphoses, and consequently represent subjects in a more advanced state of development."—*Comptes Rendus*, December 26, 1864, p. 1101.

On the Eyes of Asteracanthion rubens, Müll. & Trosch. (Uraster rubens, Forbes). By S. JOURDAIN.

When we investigate the varied forms of the organ of vision in the Invertebrata, we find that they may be referred to two distinct and fundamental types—(1) the eyes which we propose to call *idoscopic*, that is to say, furnishing images, and (2) *photoscopic* eyes, that is to say, fitted only to give a general sensation of light and darkness. The former, which are met with especially in the Mollusca, Insects, and Crustacea, are characterized by an expansion of a nerve of special sensibility, upon which the luminous rays are isolated in slender bundles by passing through a very small aperture,

* The modifications of form produced by successive moults must, in the case of the *Phyllosomata*, have given origin to many synonyms. The number of the supposed species of that form being far greater than that of all the known *Palinuri*, we are led to suppose that two or perhaps three states of the same larva have been described as so many distinct species. But this is a question which can only be solved by further investigations made in the seas where the *Phyllosomata* abound, which also can alone teach us to what exotic *Palinurus* each *Phyllosoma* belongs.

or, most frequently, concentrated by a convergent lens. In all cases the image produced is reversed.

The second kind, misunderstood or neglected by many anatomists, consist essentially of a blackish or reddish pigment, of very definite structure, impressionable by luminous rays, and in immediate relation to the nervous system in animals which are provided with the latter. The sensitive pigment does not necessarily occupy a point on the outer surface of the body; the very simple functions assigned to it may be performed when the pigment is separated from the external medium by translucent bodies—such as the exterior tegument, for example. This is the arrangement that I have met with in the Sipunculidæ; it has also been indicated in certain Annelides, especially the *Hermellæ*, in which its nature has been well comprehended by M. de Quatrefages.

Thus constituted—that is to say, reduced to an aggregation of pigment-cells in connexion with the nervous system, or, still lower in the scale, only with the sarcodic tissue, and receiving the impression of the luminous rays mediately or directly—they represent the simplest form of the organ of vision in the animal series. It is in this simple state that they have been described by Rathke in the genus *Lycoris*, and that they are met with in many other genera.

In examining recently the composition of the pigment-spots (well known to naturalists) which occupy the extremities of the rays of *Asteracanthion rubens*, we have discovered an organic perfection of the photoscopic eye which appears to have hitherto escaped the notice of observers.

The pigmentary eyes of *Asteracanthion* are situated at some little distance from the extreme end of the rays, in the interambulacral furrows. They occupy a small papilla or gemmiform tubercle, which receives a filament from the ambulacral nervous trunks; and this filament becomes dilated into a ganglion on penetrating into the papilla. The spiniform calcareous processes which terminate the arms of the Starfish surround the papilla like a sort of calyx, which, however, is open at the level of the interambulacral furrow. When, by the action of the muscles, these processes are separated from each other, the visual organ is completely exposed, and receives the luminous rays without any obstacles. When, by the contraction of the antagonistic muscles, these processes are approximated and brought into contact, the calyx closes and imprisons the oculiferous papilla; the luminous rays can then no longer reach it, and, if I may use the expression, the eyes are shut. The Starfish can therefore, at its pleasure, exercise or suspend the act of vision, and effectually protect the organ of sight from the injurious contact of external objects.

When the oculiferous papilla is examined under the microscope, the presence of the red pigment which we have already mentioned is easily detected; and it may also be remarked that this pigment does not cover the surface of the papilla with a uniform layer, but that it is distributed upon it in clearly defined and regularly distributed groups. If, with the view of ascertaining precisely the nature of these pigment-groups, a magnifying power of 300 or 400 diameters be employed, the oculiferous papilla is seen to be hollowed

by a great number of cavities, which may be compared with those of a thimble. Each of these depressions is lined by the characteristic pigment, and also connected at the bottom with the nervous ganglion, which occupies the centre of the papilla, and, as it were, forms its nucleus. The depressions are filled with a very transparent gelatinous matter, forming a slight projection at the surface of the oculiferous tubercle, and terminated by a convex portion, like the cornea of the higher animals. By the action of glycerine, this refractive matter swells up, and the projection just mentioned becomes more marked.

From the description that we have just given of it, some physiologists will no doubt be led to refer the visual organ of *Asteracanthion* to the great division of idioscopic eyes. But, notwithstanding the presence of a refractive body, which militates in favour of this assimilation, we shall regard this organ as a photoscopic eye. As in these, the pigment-cells cover the nervous element, and constitute the screen upon which the luminous rays impinge. What, then, may be the function of the refractive substance analogous to the vitreous humour that fills the capsule of the eye? It will serve to collect and concentrate the luminous rays upon the impressionable pigment, and consequently to render the perception of light, and of its different degrees, more intense and perfect.

Thus we find in the *Asteracanthion* a specialization of functions which no doubt represents the highest type of organization of photoscopic eyes, and a new example of those tendencies which nature appears to obey in perfecting organs—tendencies from which an eminent physiologist of our day has drawn such brilliant deductions.—*Comptes Rendus*, January 16, 1865, p. 103.

Notice of a new Variety of Rhodona punctata from the Swan River.
By Dr. J. E. GRAY, F.R.S., &c.

Mr. Edward Gerrard has brought to me a Lizard from the Swan River, which differs considerably from the common form of *Rhodona punctata**, indeed so much so that I was at first inclined to regard it as a new species of that interesting genus; but on reconsideration, as it only differs in the distribution of the colours, I think that it is better to regard it as a variety. It may be named after its discoverer, *Rhodona punctata*, var. *Gerrardii*. The body white, with three broad black streaks, which are continued from the head to rather beyond the base of the tail; each of the streaks is as wide as, or rather wider than, two-thirds of two series of scales. The two outer streaks commence on the side of the nose, and are continued across and along the eye and down the side of the body; the central vertebral streak commences at the back of the head. The three streaks are continued on the tail; but they become wider, and are broken up into spots, which have some more or less distinct white streaks across them. The upper surface of the hind thighs is black-spotted, the spots forming a kind of streak; the chin, belly, and under part of the tail are white.

Hab. Swan River.—*Proc. Zool. Soc.* June 28, 1864.

* *Cat. of Lizards in B. M.* (1845), p. 89.

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[THIRD SERIES.]

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XXVII.—*On the Malacostraca of Aristotle.*

By J. YOUNG, M.D., F.R.S.E., Geol. Survey of Great Britain.

PREVIOUSLY to last year we possessed no estimate of the scientific value of Aristotle's researches. That want has been supplied by G. H. Lewes, whose masterly monograph contains not merely analyses of the principal scientific treatises, but also a comparison of their doctrines with those of the present day. Meyer's work (*Aristoteles Thierkunde*, Berlin, 1855) is limited to the Aristotelian zoology and physiology. Besides minor notices in various works and journals, the classes of animals as defined by Aristotle have, in whole or in part, been made the subjects of special treatises: thus, Aubert has discussed the Cephalopoda; Gloger, the Birds; Müller, some of the Fishes; Cuvier, the Malacostraca, in his '*Mémoire sur les Ecrevisses connues aux Anciens*' (*Mém. du Mus.* t. ii.). Sundevall has identified the forms under the classes Mammalia, Aves, Reptilia, and Insecta.

In the following paper I propose to collect the notes on the anatomy and physiology of the Malacostraca contained in the three principal treatises, namely the '*Historia Animalium*' and the treatises '*De Partibus*' and '*De Generatione*,' and to give the data upon which the determination of the forms alluded to is founded.

The Malacostraca belong to the section of the animal kingdom characterized by Aristotle as bloodless. The value of the distinction between blood-having and bloodless animals has been disputed. Lewes and Meyer concur in regarding these terms as incidental characters, useful from their brevity, which saves the cumbrous repetition of details. But even a popular term, so used, must have a definite meaning attached to it. Now the groups invariably included under Bloodless are Malakia, Malacostraca, Ostracoderma, Entoma, and a miscellaneous assemblage

of undetermined animals. It is true that no attempt at classification can be found in Aristotle's writings; that the basis of classification (viz. correct anatomical knowledge, by which the affinities of animals could be recognized) was wanting; that Aristotle has expressly argued against the use of a negation as a character, and in one passage (*De Part.* i. 3) even mentioned (directly or indirectly, according to the lection adopted) this very case as one of great difficulty. Nevertheless the so frequent use of these terms, always with the same precise meaning, and the numerous physiological results of the qualities they represent, seem to indicate that to Aristotle they had more than a merely symbolical value. The implication of a positive character under the negative phrase would remove some part of the inconsistency attaching to principles so clearly and justly condemned, and so freely followed. The following passage seems to supply such a positive character:—λέγω δ' ἀνάλογον ὅτι.....τοῖς μὲν αἵμα, τοῖς δὲ τὸ ἀνάλογον τὴν αὐτὴν ἔχον δύναμιν ἢ περ τοῖς ἐναίμοις τὸ αἷμα (*De Part.* i. 5). The term *bloodless* would thus be a brief expression for animals having only the analogue of blood—an imperfect somewhat which had not undergone the "cooking" process necessary for the elaboration of blood proper. For this, *ἄναιμα* was the only word in the language. Without, however, insisting on this (perhaps overstrained) interpretation, I would point out that this division of the animal kingdom is superior to the unphilosophic one, *Vertebrata* and *Invertebrata*, to which it exactly corresponds; for while Lamarck proposed these terms with the full knowledge of the great structural differences included under the negation, Aristotle ascribes to his bloodless animals the common character of want of brain and viscera, as well as other more fanciful metaphysical qualities. It is a question worthy of investigation how far the doctrine of analogies applies to the organs described in the bloodless animals; but as its consideration will best come after the anatomy of all these groups has been described, I leave it in the meantime, my present purpose being only to supply some of the data for the solution of this and other interesting points in the history of ancient science.

The bloodless animals are, as already said, the *Malakia*, *Malacostraca*, *Ostracoderma*, *Entoma*, and a group of diverse forms which cannot be included under one common form (aspect, *εἶδος*). The diagnosis of these groups may be thus tabulated:—

- | | | |
|------------------------|---------------------------|------------------------------------|
| 1. <i>Malakia</i> | soft parts external | = Cephalopoda. |
| 2. <i>Malacostraca</i> | } " " internal { | { external } flexible = Crustacea. |
| 3. <i>Ostracoderma</i> | | |
| | | { covering } brittle = Conchifera. |
| 4. <i>Entoma</i> | body homogeneous | = Insecta. |

The separation of *Crustacea* from *Insecta* has been urged as

a remarkable generalization, far in advance of the time. On what is it based? Articulation, which makes both these subclasses members of a wider natural class, was not recognized by Aristotle. Their separation is based upon the extraordinary ground that, while in the former the hard and soft parts are distinct, in the *Insecta* the body is of a uniform hardness, "more fleshy than bone, more bony and earthy than flesh." (De Part. ii. 8.)

The above group-names are all adjectives, and, as Sundevall suggests in the case of the second, are definitions rather than names. *Scleroderma* is sometimes used for *Malacostraca*: the meaning seems identical; at least no passage suggests any gradation of hardness as implied in the different terms. They are probably all the invention of Aristotle, who several times alludes to the want of single terms to include large groups. It is scarcely necessary to remark that *γένος* and *εἶδος* have in Aristotle no fixed meaning; they are with him, as with naturalists prior to Linnæus and with most men still in ordinary talk, convertible terms, for which *kind* is the best English equivalent.

The *γένη μέγιστα* included under *Malacostraca* are *Astacus*, *Carabus*, *Caris*, and *Carcinus*. They are all Decapoda, the last belonging to the section *Brachyura*, the first three to that of *Macrura*. In arranging the anatomical and physiological details scattered through the several treatises, I have followed convenience, not Aristotle, and grouped them under the usual systematic heads. In the text, the position, not the function, of organs determines the order in which they are mentioned. The gain in clearness is counterbalanced by the necessary neglect, in this arrangement, of the interesting view we might otherwise have of the author's modified opinion in successive works. The references will be sufficient, it is hoped, for the reader to follow these changes when they occur.

Tegumentary system.—The external covering is flexible, not brittle. The earthy part is external, so as to form a kind of "kitchen" for the better conservation of such heat as is generated; for these animals, being bloodless, are of a cold nature: it is also a protection to the soft parts (De Part. ii. 8). The cause of its hardness is curious: skin is the result of evaporation by internal heat, the viscid material (*τὸ γλίσχρον*) parting with its moisture; it is, therefore, not merely because it is on the surface that this solidification takes place. The hardness of the shells in *Malacostraca* and *Ostracoderma* is due to the dryness of the viscid material in them (De Gen. ii. 6); for their heat is insufficient to cause evaporation. The important part assigned to heat in the animal economy, or at least in the speculations of ancient philosophers regarding it, is a necessary result of their ignorance of

physiology. Attempting to explain phenomena to them isolated, they were compelled to invoke the aid of some imponderable agent, whether Final Cause, or heat, or some other: what followed was the creation of dilemmas or contradictory propositions. In the present instance the same result is assigned to three causes: solidification is, on the one hand, due to heat; where that is, by assumption, at a minimum, if not wholly absent, or where evaporation could not readily be supposed to take place (as in the sea), original composition is appealed to; in a third passage, purpose is equivalent to cause.

The general aspect of the group presents two marked features, not given as grounds of division, but merely stated as differences: namely, the body of *Carcinus* is rounded, that of the other genera long (H. An. iv. 2. 5); the former is tailless, the latter have a tail with appendages, whose function as an organ of locomotion is so important that its use for the reception of ova does not seem to have suggested the analogy to that part in *Carcinus* employed for the same purpose. The congress of these animals could scarcely have been witnessed by Aristotle himself; otherwise the extension of the operculum and exposure of its appendages would doubtless have suggested its true nature to so acute an observer.

The carapace of *Carcinus* is "the case of the body, one, undivided, answering to the head and all other parts." In the *Macrura* the nomenclature is not fixed: thorax is the designation of all covered by the buckler, though there is no resemblance between this part and the similarly named cavity of *Vertebrata*, the function and organs of respiration throughout the class being alike unknown to Aristotle. The tail includes all posterior to the thorax; its lower surface is sometimes called abdomen. The terms οὐρά, κέρκος, and ὁ τράχηλος καλούμενος, the so-called neck (probably a popular phrase), are used indiscriminately. In describing the mechanism of oviposition (H. An. v. 15. 2), the intervals separating the abdominal segments from the thorax and telson (κέρκος) are mentioned; but a threefold division is not intended, since the telson of *Astacus* is called the sixth segment of the "neck." Cuvier found, in ἡ κέρκος, πτερύγια δὲ πέντε, of *Carabus*, ἡ οὐρά καὶ πτερύγια τέσσαρα of *Caris*, indications of structural difference; but the expressions are synonymous. The use of the tail as a swimming-organ is of course noted, and mentioned as a very important distinction between the kinds of *Malacostraca* (H. An. i. 1. 8). It is absent in *Carcinus*, because it would be useless to an animal whose only mode of progression is ambulatory (De Part. iv. 8). The dependence of structure upon function is stated twice afterwards in the same chapter. The reasoning is in accordance with that

of several other passages: one in the previous chapter is cited by Lewes as at variance with the notion which attributes the absence of limbs in Ostracoderma to their sedentary habits, but seems to admit of an opposite rendering:—"For those animals capable of motion must of necessity have many limbs, because their actions are (many); for those partaking of several movements have need of several limbs" (De Part. iv. 7). The modern doctrine, which sees in successive modifications of structure the influence of change of habit resulting from altered conditions of life, finds in Aristotle no anticipation. Of that doctrine the variability of the species is a postulate. But Aristotle sums up his views regarding the persistence of a type in one sentence, which explains the presence of pincers in *Astacus*:—"they must have pincers, because they belong to a kind which has them" (iv. 8). The future consideration of Aristotle's intermediate forms will give occasion to analyze in detail his opinion regarding the series of organized forms. Meanwhile it is enough to recall that he recognized no passage, in the modern sense, from one to another. To an advocate of spontaneous generation it was logically inconsistent to admit transition; the number of known forms was then too small to allow the recognition, even empirical, of any true passage; even supposing that anatomical research had been more than rudimentary, and had not been limited to such facts as might be obtained by simple inspection. Further, in disproving certain popular errors in teratology, he insists upon the essential differences in the period of gestation as negating the possibility of mixed forms (De Gen. iv. 3). Again, life was to him the active or productive essence of the organism. It had therefore that shadowy impersonation which was ascribed to all the energies in the philosophy of his and far later times; but it was not an abstraction distinct from the organism. Not only was it as a whole "the energy and faculty" of the body as a whole, but its different *δυνάμεις* find in each part a corresponding *δύναμις*. Since therefore the primary *δύναμις* is that to which the subordinate *δυνάμεις* have reference, and since form is not so much the result as the concomitant of this essential property, it necessarily follows that the manifestation of this final cause must be invariable for every organism (De Anima, i. 3; De Part. i. 1). Admitting its permanence, and assured of its antecedence to the matter whose changes it determines, we can find for the passages above quoted no other interpretation than that which subordinates structure to function.

The anterior part of the body, that surface on which the mouth is placed, is called the face. The forehead includes the rostrum and supramandibular space. Beneath the eyes are the antennæ

(κέρατα, horns), which in *Astacus* are said to be six, the inner bifid pair being counted as four, their single basal stalk being overlooked. These are not spoken of as organs of touch, their use as weapons of war being the only one assigned them. In the ordinary movements of the animals, they are applied to the sides; but, when alarmed, they are projected while the animal retreats. The mouth, with its two teeth, which are constant in all Malacostraca, next follows. Between the teeth is the tongue, which, as an organ of nutrition, is said to be necessary in all animals (De Part. iv. 5). Beneath the mouth and above the pincers or "great feet" are limbs whose position is not quite correctly stated, while their functions are very vague. The two hairy feet with their thin appendages are evidently the third pair of jaw-feet with their flagella: they are below the mouth; but it is said that a little below them are other hairy branchioid organs, numerous in *Carabus*. They are in constant motion; their function is the reception and emission of water (H. An. iv. 2; De Part. iv. 8). These are clearly the first and second pairs of jaw-feet, with their appendages, placed below the third pair by confusion of the normal position of the animal with that in which it was placed for examination. This description of the face is drawn from *Astacus*. In the following chapter (H. An. iv. c. 3) the parts of *Carcinus* are sketched, and the first pair taken from among the branchioid parts, and called the sheaths of the teeth (ἐπικαλύμματα ἐπὶ τῶν ὀδόντων). Upon the passages iv. 2. 30 and iv. 3. 3, as well as upon each other, commentators have bestowed much labour, learning, and sarcasm. The text is certainly obscure, the terms somewhat indiscriminately used; but much of these ponderous treatises might have been spared, had it been borne in mind that accuracy was impossible to a writer who denied the existence of respiration in these animals (De Part. iv. 5), and who makes no mention of the branchiæ or their cavities, who even denies their existence, as appears from this passage (H. An. viii. 2. 4):—"Those blood-possessing animals which use the water in a fashion analogous to respiration have branchiæ; those using it for the sake of food have a tube [blow-hole]. Similarly the Malakia and Malacostraca; for these imbibe the water for the sake of nourishment." That the branchiæ were not included under the hairy branchioid oral appendages appears from this passage (De Resp. 12):—"The *Carabi* and *Carcini* discharge the water by the hairy members through the sheaths (παρὰ τὰ δασέα διὰ τῶν ἐπιπτυγμάτων)." The following literal translation of the two passages in the 'History' seems the best that can be made of them:—"All these animals admit sea-water by the mouth, and gradually contracting this part, discharge it, (as do) *Carcini* and *Carabi* by the branchioid members; now

Carabi have these members numerous" (iv. 2. 10). "It [*? Carabus*] receives the water by the mouth (pushing aside with the sheaths), and discharges it by the upper apertures of the mouth (covering with the sheaths those by which it entered); and these [apertures] are straight below the eyes [and when it has received the water, it covers the mouth with both the sheaths, and thus squirts out the sea]" (iv. 3. 3). The clause [] is by Schneider considered of later date—a marginal interpolation; it seems further as if those marked () were also annotations or attempts to connect with the acts described the constant motion of the branchioid structures; for, besides the awkward elliptical form of both, the latter separates, very inelegantly, οὔτοι from τοὺς ἄνω πόρους τοῦ στόματος, to which it evidently refers. In the first passage, the text, as amended by Schneider, is adopted on account of the support it derives from the quotation *De Resp.*; though there is still a little difficulty left in the relation of οἱ τε καρκίνοι καὶ οἱ κάραβοι to the rest of the sentence, and the removal from its right place of an important part of the process παρὰ τὰ βραγχώδη. The subsequent insertion of the illustrative genera as a note is probable from the structure of the sentence, of which they cannot originally have formed a part. Without entering into a minute analysis of these passages, it seems evident that Aristotle was aware of the return of the water by the external efferent apertures, which he wrongly thought to open into the mouth, and therefore, equally wrongly, attributed the expulsion to the coincident approximation of the maxillæ. The respiration in Crustacea is the subject of an excellent paper by Milne-Edwards (*Ann. d. Sc. Nat. sér. 2. t. xi. Zool. p. 129*), in which the part played by the maxillary appendages is experimentally demonstrated. The repetitions, obscurity, and inelegance of chap v. induced Schneider to regard it as not authentic; but he seems to have been led to this opinion by the attempt to find in it the true theory of respiration, which, I have shown, it could not contain. More likely is it that additions have been made, either by Aristotle himself, as more information was obtained or new opinions formed (thus the first pair of jaw-feet are in it described as sheaths), or by zealous commentators anxious to make clear concise statements of facts with which they were profoundly unacquainted. The extension of the influx and efflux of water to the whole group depends upon a disputed reading, κοινὸν δὲ πάντων τούτων ἐστὶν ὀδόντας πάντα ἔχειν δύο, or τοῦτό ἐστιν ὀδόντας τε (*Hist. iv. 2. 10*): the latter seems the more probable version; but, as we have only probabilities to guide us, their discussion is fruitless and unnecessary.

The feet are ten in number, in all but *καρὶς κυφὴ*, whose

abdominal appendages are considered equivalent to the thoracic limbs. The motion of the feet is lateral, like that of the legs in insects: progression by their aid is diagonal, as in quadrupeds, in whom, however, two alternate and opposite feet precede the corresponding members of the pair to which each belongs; while in *Carcinus* the alternation is by four feet at a time (H. An. i. 5. 7; De Inces. An. 14). The posterior feet of the small semiparasitic *Carcini* are flat, "so as to be useful for swimming" (De Part. iv. 8). The oblique motion of the pincers is adapted for conveying to the mouth the food grasped by them. Those of *Astacus* are minutely described, and the tooth-like arrangement of the tubercles suggests their comparison with jaws, of which the upper is moveable, the lower fixed. The absence of pincers in *Carides* is attributed to the number of the other feet, on which the material is used up. This number is in consequence of their natatory habits—doubtless a reference to the flat tips on the majority of their limbs. The teleology of this chapter (De Part. iv. 8) has already been spoken of: in the last quotation we find another instance of the law of economy which Aristotle had stated long before the time of Geoffroy St.-Hilaire, by which he explains the small tail of the bear, &c., and of which he makes a more correct use in his acute explanation of the mutual relations between fat and sperm (De Part. ii. 5).

The description of the abdominal appendages is very obscure. The hairy plates, *πλάκας*, to which the ova are attached are said to be four in *Astacus*. Did the position of the first pair nearer the middle line than the others exclude them from the reckoning? In Hist. v. 15 they are said to accompany each somite of *Carabus*, and are therefore five. It is they probably, not the ova, which are meant as being largest in the middle, the last being the smallest (H. An. v. 15. 2). This version is in accordance with a previous passage, where the female is said to have these appendages *μεγάλα καὶ ἐπ' ἐλάττον τὰ πρὸς τῷ τραχήλῳ* (iv. 2. 5): the clause which follows (*ὁ δ' ἄρρην ἐλάττω καὶ οὐκ ἐπαλλάττοντα*) is rejected as spurious; it is, at any rate, unnecessary, since the overlapping which it states to be absent in the male is not properly opposed to any arrangement in the female, the present chapter (v. 15) denying it in her also. If, therefore, the clause is retained, *ἐπαλλάττοντα* must be read *ἐπ' ἐλάττον*.

The cloacal office of the anus is stated clearly (De Gen. i. 15): "In the *Malacostraca* and the like, the passage for excrements and the uterine duct is the same: it is by this passage that the seminal fluid is discharged." It is this sentence which makes intelligible the remark that the ova are not continuous with the duct, but are on the middle of the body, which is separated by

an interval, as already described, from the tail. The "cartilages" are divided into several parts, meaning probably the outer and inner plates of the abdominal feet. These are not only, like the operculum of *Carcinus*, larger in the female; but they enlarge towards the end of gestation for the reception of the ova, which are brought to their places by the bent and adpressed tail. The epicalymmata or opercula, as the outer plates of the somites are called, not being able to cover the mass of ova, the incurved tail assists, overlapping them like a lid. The mechanism in *Carcinus* is not alluded to.

These animals in spring, and in autumn after generation (H. An. viii. 19. 5), cast a slough like serpents, but not, like them, in one piece, since individuals have been caught with one half of the body soft, the other still hard. This occurs not once, but often: it is said elsewhere to occur both immediately after birth (εὐθὺς γυγνόμενοι)? and later (v. 15. 6). During the process they are weak and unwilling to move, concealing themselves till their integuments recover their hardness.

Sexual distinctions.—These are the presence or absence of pincers, variations in their size when present, the development of spurs on the last pair of feet, the larger size of the abdominal plates in the female. Uncertain as we are as to the exact animals referred to by Aristotle in these observations, their accuracy, except as to the abdominal plates, cannot be tested. The inequality in size of the pincers of *Astacus* is rightly shown not to be of sexual value. The female *Carcinus* is altogether larger than the male; her operculum in particular is broader and rougher. This relation of size to the function of reproduction is also noted among insects.

Digestive System.—The presence of teeth (= the mandibles) in all Malacostraca is stated: in *Carcinus* they are round, not long. The tongue, or rather its analogue, is mentioned as an essential organ in all animals (De Part. iv. 5). Though stated to be between the teeth, the whole mouth seems elsewhere possessed of the function of taste.

The stomach follows the mouth, though separated from it, in *Carcinus* and *Carabus*, by an œsophagus small in proportion to the size of the body (De Part. iv. 5). The stomach is membranous, and provided with teeth at its mouth—an oversight due to the close approximation of the cardiac and pyloric orifices, to the latter of which they properly belong. They are not present in all *Carcini*—a doubtful statement. Their purpose is to triturate the food insufficiently acted on by the oral teeth. From the stomach, which in *Carcinus* is said to be double (though the remark applies equally to the other members of the group), the gut, simple, of equal thickness throughout, passes

to terminate at the tail. As already said, it is regarded as the common passage for excrements and ova. To this *Carcinus* does not seem an exception; for though the clause following that in which the vent is placed in the middle of the operculum is not very clear, it cannot be regarded as an admission of the distinctness of the genital apertures: ἐκτὸς δὲ καὶ οὗτοι (or τούτοις) ἢ τὰ ὡὰ ἐκτίκτουσιν (H. An. iv. 2. 10). The emendation in brackets does not help us much; for not only is its authority doubtful, but there is nothing to which τούτοις can refer except τὸ ἔντερον: besides, waiving the grammatical difficulty, the vent is not external to the genital apertures. All it can be held as affirming is that the products of generation reach the surface. We learn from other passages that it was by the vent.

The position of the gut is dorsal, and separated by the muscular mass from the genital ducts, as in quadrupeds. This is not the fact, as will appear from his own statements under the generative organs. The analogy is probably suggested by those male quadrupeds in which the external organs are slung along the under surface of the abdomen (H. An. ii. 1. 3); but this will not apply to the female.

Other viscera there are none (De Part. iv. 5). "None of these animals have blood from which arises the nature (ἡ φύσις, the originating principle, Lewes) of the viscera, because the condition (πάθος) of their existence (i. e. of the viscera) is some such condition (πάθος) of it, i. e. τῆς φύσεως. For that there are bloodless and blood-possessing animals lies in the Final Cause (ὁ λόγος) which determines their being. Further, those things for which blood-possessing animals have viscera are wanting in these (the bloodless); for they have neither veins, nor bladder, nor respiration; but only it is necessary for them to have the analogue of a heart; for the sensitive part of the soul and the cause of life is present in all animals, in some element of the organs and body." But this heart is here a metaphysical, not an anatomical organ; it is conjectured to exist as the seat of sensation. The only contents of the shell, then, are, besides the digestive apparatus described and the generative organs, a pale fluid, the μύτις or μήκων, the diffuent hepatic mass so named in *Malakia* and *Ostracoderma*.

The *Malacostraca* are said to be omnivorous (H. An. viii. 3. 5), devouring stones, wood, dung, and flesh; their food is carried to the mouth by the pincers. How they acquired the reputation of eating stones and wood is not easy to see.

The digestive organs have plainly been examined by Aristotle, but in no way justifying his being called an anatomist: the separation of viscera has not, as will appear under the generative organs, been attempted. Everything stated is ascertainable by simple inspection.

Organs of Sense.—Sensation (or, more correctly, sensibility) Aristotle held to be essential to all animals. This logical inference rendered necessary the logical heart just mentioned, which is thus assumed to exist on grounds very far from practical*. The special senses possessed by the *Malacostraca* are those of taste and vision, smell and hearing. The first resides in the tongue, sight in the mobile eyes. The place of eyelids is supplied by the hardness of the eye. To counterbalance the dimness of vision supposed to result from thus, so to speak, looking through the hard eyelid, motion is given to the organ, so that it may turn towards the light (*De Part.* ii. 13). Smell and hearing are referred to no special organ; the former is held to exist because baits are used with success in the capture of these animals. The olfactory sacs of Rosenthal (auditory of Farre) were necessarily unknown, as was also the capsule at the base of the outer antennæ, to which the function of hearing is ascribed. Both organs are as yet known in only a small number of the class; while the phenomena ascribed to these two senses are experimentally demonstrable as at least in part due to the operation of the other senses.

Generative System.—The existence of penetrating organs is expressly denied in the case of *Carcinus*; and their absence in the group generally is the basis of remarks on impregnation, to which we shall again recur. The genital apertures beneath the last pair of feet in *Caris* are mentioned, but, as will appear, with no reference to their true function. The ova are alongside of the gut—a general remark applicable to all the group (*H. An.* iv. 2. 11). In *Carabus* a duct is described as passing from thorax to vent, on the lower surface of the fleshy mass. It is present and identical in both sexes, being devoted to the proper secretion of each. The successive branching of these ducts is not mentioned here, but occurs in the ‘*De Generatione*’ (i. 17). Not only are they similar in aspect; their contents, a pale fluid, are similar also. This could only have been a note descriptive of their appearances in specimens examined after reproduction; for in a subsequent chapter the ovary of *Carabus* is said to be contracted at intervals (ἔχει ἐντομὰς), its appearance during the earlier period of gestation; and the red colour of the eggs, which he knew of, could not have escaped notice, had they been seen previous to extrusion.

Another teleological enigma is presented by the male genital organs. Testes are intended as regulators of, or rather checks upon, the procreative instincts (*De Gen.* i. 4); in animals of cold habit they are therefore unnecessary. But the passages

* Compare *De Anima*, i. 5 *et seq.*, ii. 2. 11; *De Part.* ii. 8. 10, iv. 5.

quoted bring into prominence the windings of these ducts in animals of a cold habit, in whom he finds no sufficient cause for the movements of the sperm being retarded.

The ova and spiral ducts are similar in *Caris* (H. An. iv. 2. 13): the spiral arrangement was not alluded to, however, in *Carabus*. "Peculiar to the male are two white bodies, similar in colour and structure to the proboscis of *Sepia*; they are convoluted like the μήκων of *Buccinum* (? κήρυξ); they begin at the cotyledons beneath the last feet. There is also in it (*i. e.* the thorax) a flesh-like substance, red and blood-like in colour, clammy to the touch, and not similar to flesh. From the convoluted mass just mentioned there is another spiral (duct) like a thread in thickness; beneath these are two granular masses attached to the seminal duct [in Schneider's text, two granular seminal bodies attached to the gut]. Such are the parts in the male. The eggs (ovaries) of the female are red; their attachment is near the stomach and on either side of the gut as far as the flesh-like bodies, being surrounded by a thin membrane."

I have given this passage as it stands, confessing my inability to unravel the anatomical statements it contains. In the treatise 'De Generatione' (iii. 8) the ovaries of *Malacostraca* are said to be double; the genital duct may therefore be inferred to be double. The duality of the organs in *Caris* is clearly stated: what these organs are is not so clear. The granular hepatic organ of the *Squilla* lies on either side of the gut, and may have been taken for a genital structure. But for the precision with which the genital passages are said to terminate in the vent (*De Gen. loc. cit.*), the testes would seem to be correctly described. The corresponding apertures in the female, however, are not recognized; and since the ovaries are only traced to the flesh-like masses, *i. e.* probably to the point opposite the second pair of feet, where they turn downwards to reach the surface of the body, they at least seem supposed to pass to the usual termination. The two granular bodies may represent the bursæ copulatricæ; but what of the thread-like spirals? It is possible that some of the testicular ramifications are meant, not discovered to be integral parts of the mass. If anatomists have erred in more recent times, with fuller knowledge and better appliances, the acknowledgment that Aristotle is obscure at least, if not inaccurate, may be safely made without detracting from his merit, more especially when we remember that functions, not structures, were the chief objects of his studies. Every reperusal of the 'History of Animals' strengthens the impression that, as it now stands, it is an unfinished treatise—as it were, the rough draft in which memoranda were inserted as they occurred.

Congress takes place in the spring (H. An. v. 6). Among

the *Macrura* it is effected in the same way as in retromingent quadrupeds, the female raising the tail so as to bring the cloacæ in contact. The *Carcini* oppose the ventral surfaces, their opercula being laid together. The prolongation of the act, which permitted its being watched, is the result of their bloodlessness and consequent cold habit. The necessity that the male secretion should be applied to the eggs previously to extrusion leads Aristotle to argue elaborately against the then alleged impregnation of fishes by swallowing the male fluid, and even to doubt the effusion of that fluid over the extruded ova. The parallel development of the secretions in each sex, and their simultaneous maturity, are sagaciously urged in support of his conjecture that congress takes place, though so rapidly as to elude observation. The subsequent effusion over the ova would then be a sort of economy by which the secretion is used up. As a final proof that impregnation must take place during contact, he points out the position of the eggs in *Malacostraca* beneath the body of the female as rendering impossible any interference on the part of the male. The "cold habit" of these animals entails a dilemma for which he offers no explanation. Having elsewhere stated that fish are of a cold habit, and here conjecturing a very short contact, he nevertheless attributes the prolonged contact of *Malacostraca* to the same thermal conditions. His physiology was more correct than his metaphysical heat theories.

Gestation lasts for three months, in *Caris* four. After remaining attached to the female for about twenty days, the ova are thrown off in a mass outwardly undivided. In fifteen days more, the perfect individuals issue. The ova of this group are not eggs in the true sense (*H. An. i. 4. 1*), nor are they scoleces, but intermediate—a character they share with those of fish; and in both it is a result of "cold habit" (*De Gen. i. 8*). Their development takes place after extrusion. They "are cooked" in *Crustacea* while attached to the parent (*H. An. v. 15. 4*), the evidence of which is their increase of bulk. This increase Lewes, after Auber, attributes to endosmosis, if indeed it occurs at all. The alleged imperfection of the *Malacostracous* egg seems to be in great part an assumption demanded by the thermal speculations so prominent in these treatises—to be, not observation, but inference. It is not stated how the external hatching-process conduces to a development which the internal warmth, such as it is, is insufficient to mature. Having, however, assumed the imperfection of the egg, it is necessary to explain it. We have seen that it is the result of the cold nature of the parents; its purpose is to save the race from extinction: the number of eggs required to be laid, so that some may have a

chance of escaping destruction necessitates their extrusion in an imperfect state; for were they to be retained till mature, their number would be diminished and their chances of destruction increased. To this end also is adapted their rapid development when without the body, as they thus more speedily overpass the precarious age (De Gen. i. 8). Again, the eggs of birds acquire their hard covering on the cessation of growth; those of cartilaginous fishes remain soft because the parent body has not sufficient warmth to dry up the outer covering (*ibid.* 10). In Malacostraca no period is assigned at which the shell acquires its density; on the contrary, growth advances, even though the shell is hard. Again, the relation established between the outer covering and that of the egg (De Gen. ii. 1), though perfectly applicable to the Malacostraca, fails utterly in other groups of animals, and is at variance with the teleological speculations just stated. But, contradictory as are these statements, it must not be forgotten that the facts are themselves no less puzzling. The true theory of generation is only of late and very slow growth. How nearly the searching intellect of Aristotle approached that theory may be seen in Lewes's masterly sketch of its history. The reader will there find proof of the wonderful sagacity Aristotle showed in his observation and reasoning regarding embryology in beings less obscure than the Malacostraca, whose eggs he was entirely destitute of the means of properly studying.

Such is the account given by Aristotle of the anatomy of Malacostraca. The facts are few, obscurely stated, sometimes erroneous: they are all such as could be obtained by simple inspection: dissection there was none. For the genital passages are not traced to their terminations, but are lost sight of where they dip to reach the external apertures; their further course is guessed, and guessed wrongly as towards the tail. The muscles are not mentioned; for if these organs were not understood in the Vertebrata, much less would they be intelligible in these animals; they are probably the pale substance of which he speaks. An omission more remarkable is that of the power possessed by these animals of reproducing lost parts—a fact which seems also to have escaped the notice of the fishermen from whom he derived so much information.

It has been conjectured that Aristotle had a more extensive knowledge than his anatomical statements indicate. That he knew more species than he has named is very probable; but we may safely assume that, in treatises looking at structures from different points of view, he has made use of all the structural information he possessed. It must be remembered that the main

object of his studies was the explanation of the phenomena of life. We now know that accurate anatomy is the only sure basis of physiology: but the speculations of that age followed an inverted order. Descending, as Aristotle traces thought, from universals to particulars, the order of ideas was supposed to represent the order of events. A Final Cause was assumed as the starting-point; the facts were viewed as its manifestations. How that operated in multiplying difficulties I have pointed out. Its cramping influence was rebelled against by Aristotle:—"It is true that nature sometimes uses excretions to some good end; but we must not therefore seek a final cause in all things, but, inasmuch as certain things have certain properties, there will necessarily arise from these many effects." (De Part. iv. 2, quoted by Lewes, p. 318.)

The identification of the animals from which the foregoing anatomical details were drawn has, of course, been frequently attempted. Belief in the infallibility of Aristotle led to many arbitrary interpretations, which it might be interesting, but would assuredly be unprofitable, to restate. The essay by Cuvier, "Sur les Ecrevisses connues aux Anciens" (Mém. du Mus. t. ii.) and the chapter in Meyer's 'Arist. Thierkunde' on the Crustacea are the most recent dissertations on the subject with which I am acquainted. There is not in English, so far as I am aware, any special treatise on the Malacostraca.

The γένη μέγιστα of the group have been already mentioned. The γένη or εἶδη included under them are—

Astacus. 2. Fluvatile *A*.

Carabus.

Caris. 1. κ. κυφή. 2. κράγγων. 3. τὸ μικρὸν γένος.

Carcinus. 1. *Maia*. 2. *Paguri*. 3. *Heracleotici*. 4. River

Carcini. 5. Small forms, unnamed.

Astacus.—The description of this form (H. An. iv. 2. 6) leaves no doubt as to its identity as a member of the family Astacina, probably the *Homarus vulgaris*, M.-Edw., a common Mediterranean species. *Nephrops norvegicus* also occurs in the Mediterranean; but as the only recorded localities are in especial the northern parts of the Adriatic, and points westward of that gulf, this noble representative of a former fauna seems not common on the Grecian coasts.

The diagnostic characters mentioned are:—the three anterior foot-pairs are didactyle; the pincers are larger than in *Carabus*, unequal, with sharp spines along their outer margin; the outer antennæ shorter than in *Carabus*, the inner bifid, or rather, as Aristotle describes them, two on each side; the eyes are smaller

than in *Carabus*, but the rostrum is larger; the smooth surface and larger body also distinguish it from that animal.

Heller (Die Crust. des Süd. Europa, 1863) mentions, besides the Mediterranean forms *Homarus* and *Nephrops*, seven species of freshwater *Astaci*, to one or more of which Aristotle probably alludes when he speaks of fluviatile forms of this genus. Were our knowledge of the zoology of southern Europe as minute as we could desire, it would be impossible to speak positively on this and other questions of identification without some certainty as to the locality where Aristotle's observations were chiefly made, whether at Athens or in Macedonia, and as to the possibility of species being brought from distant countries. To speculate upon the particular forms which *may* be included under the general names he uses is therefore simply to waste time.

Carabus.—The diagnosis given under *Astacus* contains all the data upon which an identification of this form can be founded. But one point is especially of interest. The opening statement that *Astacus* and *Carabus* have not pincers is in direct contradiction to many subsequent passages in the 'History of Animals' and in 'De Partibus,' in which the pincers of the latter animal are taken for granted and their uses described. The first contradiction occurs in the same chapter, a few lines further on, where the didactyle first pair of the female is her sexual distinction. At the same time the male has on the last pair spurs larger and rougher than those of the female. To reconcile these conflicting statements is impossible, without unwarrantable interference with the text. Meyer's suggestion is both critically sounder and more in keeping with the laxity so common in Aristotle's descriptions. He finds "the rough spiny carapace, the short rostrum, the large lateral and the shorter inner antennæ, the large eyes, the five swimming-plates of the telson, the large false feet of the female, and the red ova" characters sufficiently marked to justify their acceptance as descriptive of *Palinurus vulgaris*. The contradictions as to the pincers he holds as proofs that Aristotle was acquainted with other forms, but has neither named nor described them, save in these incidental puzzling allusions. The great length of the third pair in *P. vulgaris* might have been expected to require some notice. Again, in the allied genus *Scyllarus* it is the last pair, not the first, which is didactyle in the female. The development of the spurs is therefore sexually the reverse of that stated in the text. But in *Scyllarus* the oostegites show the decrease posteriorly which, according to the lection I have adopted, is asserted in the description of the auxiliaries to oviposition. In *S. latus*, moreover, the spines there mentioned on the lateral parts of the abdominal somites are well marked. If then we confine our

attention to the 'History of Animals' (B. iv. c. 2), we find the characters there stated generally applicable to the Loricata of Van der Hoeven's classification. But, considering the other passages in which the pincers of *Carabi* are referred to as descriptive not of sexual but generic characters, and looking elsewhere for forms which without violence may be supposed to have, in part at least, contributed to a description probably written chiefly from memory, the genera *Gebia* and *Calliaxis*, separated by Heller from the Astacina, and placed between that family and the Loricata, present the chelate first pair, and are probably included in the term *Caraboid*, which is frequently used for *Carabi*, and, though sometimes perhaps including *Astacus*, may be held as limited to the Loricata and allied forms unnamed.

Of the families Loricata and Thalassinidæ eight genera and eleven species are found in the Mediterranean.

Karis.—The animals of this group have an elongated body like *Carabus*, but are without pincers. The number of feet exceeds ten; their arrangement distinguishes two groups: αἱ κυφαὶ have five pairs, those next the head being sharp; they are followed by other five pairs, whose extremities are flattened: abdominal appendages are wanting; the surface of the body is similar to that of *Carabus*; the central plate of the tail is spinous and pointed. Ἡ κράγγων, on the other hand (τὸ ἀνάπαλιν) has first two pairs (four feet) flat, then other three pairs of slender feet; the posterior part of the body is without feet; the central plate of the tail is spinous and broad. The precision with which these characters are stated at first sight gives hope that they will be easily used in identification. But it is not so: the identifications hitherto proposed are beset with difficulties, whose solution requires the previous assumption that Aristotle has been too negligent in his observations, or has shown unusual precision in assigning to limbs their morphological values. Guided by the description of the tail, Cuvier has recognized in the former the Crevette (*Gammarus locusta*), in the latter *Squilla Mantis*. In so far as this interpretation rests upon the lection adopted in the first clause descriptive of κράγγων, I cannot see much force in Meyer's objection to Schneider's rendering. Having placed the sharp claws anterior to the flat in αἱ κυφαί, Aristotle goes on, Ἡ δὲ κράγγων τὸ ἀνάπαλιν τοὺς πρώτους γὰρ ἔχει τέτταρας ἐφ' ἑκάτερα [πλατεῖς], εἰτ' ἄλλους ἐχομένους λεπτοὺς τρεῖς ἐφ' ἑκάτερα κ. τ. λ. Granting that ἀνάπαλιν does not necessarily mean "reversely," yet the antithetical construction of the following sentence seems to require in the first clause a descriptive adjective corresponding to λεπτοῦς: πλατεῖς is that most naturally suggested by the foregoing passage; but

both etymology and custom give ἀνάπαλιν the sense of reversal here required, and thus complete the meaning, if not also the structure, of the sentence without changing the text. The objection is the less called for, since Meyer has already, in accepting *Palinurus vulgaris* as the representative of *Carabus*, inferentially admitted that Aristotle has neglected to notice the peculiarity of the third foot-pair in that animal—a peculiarity surely as striking as that whose omission, not unaccountable in a work by no means aiming at minute accuracy, has led him into this specious argument. In considering the abdomen as destitute of feet, Aristotle does not so much distinguish the two classes of appendages (a distinction of which this would be a solitary instance) as he is led, by their size and position, to regard them as portions of the deflected somites.

Αἱ καρίδες αἱ κυφαί, resembling *Carabus* in the surface of the body, cannot be identified as belonging to the smooth genus *Palæmon*, especially when the pincers terminating the first two foot-pairs are taken into account. *Crangon vulgaris*, to which Cuvier refers them, is poorly supplied with asperities, though the sharp terminal article of the first pair and the general character of the appendages in the genus *Crangon* approach nearer than *Penæus caramote* to the brief data given by Aristotle.

We are thus brought to the conclusion that the materials supplied by the text are insufficient to form the basis of any reliable conclusion. It is better meanwhile to rest satisfied with the conclusion that probably some members of the family Caridina are alluded to, and that Aristotle, in describing them, probably wrote from memory. The list of Mediterranean forms belonging to this group is large. Heller enumerates eighteen genera, containing thirty-nine species, most of which have a wide range. Of the remaining *Carides*, τὸ μικρὸν γένος, we have no other information than that their small size is a permanent condition: they are therefore not the young of any other form. Cuvier's reference of them to *Cancer locusta* or *C. Crangon*, therefore, cannot be relied upon.

Carcinus.—We come now to the Decapoda Brachyura, or, in Aristotelian language, ἀνορθόπυγια; for, as already said, he did not recognize the operculum as the incurved post-abdomen. This group is uncountable and most various. The subgroups are enumerated in the order of their size; and the groups so formed have been accepted by Cuvier, Milne-Edwards, and others, as natural. They have therefore been recognized in *Maia* the *Maia squinado* or *Platycarcinus pagurus*. Milne-Edwards identifies *Heracleotici* as *Thelphusa fluviatilis*, on the ground of their resemblance to forms seen on certain medals; but he has forgotten that the fluviatile forms are specially mentioned in the

same passage with the *Heracleotici*, and has certainly neglected the caution he himself rightly gives against the determination of species from inexact data. He further regards the *Pagurus* as *Cancer pagurus*. Other fancies it is needless to mention: the long list of *Brachyura* given by Heller as occurring in the Mediterranean is large enough to select from; but, as there is no reason for choosing one form more than another, the task is not profitable. For, besides the enumeration above given and the anatomical statements extracted in the previous part of this paper, only one other passage contains any zoological information regarding species (De Part. iv. 8). In that passage the *Maia* and *Heracleotici* are said to be of sedentary habits, and therefore having weak limbs, which in the former are thin, in the latter short—characters not strictly applicable either to the modern *Maia*, or to *Amathia*, the conjectured representative of the *Heracleotici*. Meyer shrewdly points out that inquiry is arrested by the preliminary difficulty of determining how far the groups thus arranged in order of size represent natural divisions. In this unsatisfactory conclusion we must perforce concur. Of the smaller form we shall immediately speak. But first there are some members of the division named but not referred to any of the groups indicated by Aristotle. On the Phœnician coast certain animals, called ἰππεῖς on account of their speed, are referred by Milne-Edwards to *Ocypoda*, of which the species *O. cursor* is found in the islands of the Archipelago. Another animal (ἄρκτος) is once mentioned as similar in its reproduction to *Carabus*; but, as it occurs nowhere else, its determination is impossible: we cannot tell even what form it most nearly resembled.

It remains to speak of the smaller forms. These belong to the *Carides* and *Carcini*. Whether the small form of the former is referred to its place with the same generic precision as such a statement would now imply, or whether it is merely equivalent to saying that it is one of the *Macrura*, we have no means of deciding. The comparison of some forms with *Carabus*, and others (perhaps the same) with *Astacus* leaves an uncertainty, not diminished by the repetitions occurring in the two chapters in which they are spoken of at the greatest length (H. An. iv. 2, 3).

Three forms of the small *Carcinus* admit of identification, namely that found in the shells of *Strombi* and that in those of *Nerita*. The long antennæ, the fixed eyes directed anteriorly and supported on long peduncles; the shell, less dense than in *Carcinus*, casing thorax and feet, while the hind body is soft, are characteristic of the genus *Pagurus*; while the larger right pincers and longer body of the inhabitant of *Strombi*

specially mark *Cancer Bernhardus*, the larger left pincer being equally distinctive of *Diogenes varians*. Their anatomy is very briefly stated. The interior of the soft body is pale: they have an œsophagus terminating in a stomach; but the vent is not evident: no hint as to the direction of a gut. They are not attached to the shell which they occupy, like the animals of *Purpura* and *Buccinum*, but change from a smaller to a larger one as their increase in size compels them. The small *Carcini* with the last article of the posterior feet expanded into an oar-like member are probably the *Cancer depurator*. Another form (*κύλλαρος*) occurs in bivalve shells. Following as it does the description of the *Cancris* just mentioned, it probably belongs to the genus *Carcinus*; but no *Pagurus* is so found. Aristotle afterwards speaks of those in bivalves as small white *Carcini* (v. 13. 9); yet a few lines before they are said to be either *Cari-dion* or *Carcinion*. Whether therefore they are small *Anomura* or *Macrura*, or intended as members of both groups, it is not easy to say: probably the latter is the correct view. Certain it is that his *Pinnophylax* or *Pinnotheres* is the species now known as *Pinnotheres veterum*. Several small *Brachyura* frequent the large byssus of some *Lamellibranchs* and the cavities of *Sponges*. In the latter locality *Forskål* detected two species, *Cancer tridentatus* and *C. dentatus*. I do not know the grounds of Aristotle's statement that they cast webs across these cavities, and thus catch their prey; it has, however, apparently suggested the comparison of *C. Bernhardus* to a spider, to which it has some resemblance when, semiretracted, the feet are gathered close to the head.

The relations of these animals were a puzzle to Aristotle; and the difficulty may be taken as a measure of the system, or rather want of system, in his zoology. They are described along with the *Ostracoderma*, to which he says they in some way belong, as, though like *Malacostraca*, they occupy shells; but having no organic connexion with the shell, passing even from one shell to another, he considers them as intermediate between the two groups. How strong seemed their affinity to that with which their connexion is only accidental may be inferred from their being thought to originate in the same way—namely, from mud and sand. Even the fisherman's story, that the *Pinnotheres* comes into being along with the *Pinna*, is quoted, apparently with approval.

In the preceding statement of the most recent opinions on the identity of these forms, I have not alluded to the statements of other authors, Greek and Roman, bearing upon the *Crustacea*, partly because it seemed better to make clear the data given by

Aristotle, partly because to have done so would have been to anticipate the results of a wider inquiry. Probably many other members of this class were known to Aristotle than those he has named; probably, also, these unknown animals have, by taking a share (whose limits it is useless to attempt to define) in the descriptions we have been studying, helped to increase the confusion and uncertainty.

The following table contains the systematic classification of the Malacostraca mentioned by Aristotle, and their probable equivalents. The classification is that of Heller, *op. cit.*

CRUSTACEA PODOPHTHALMIA.

Brachyura.	.....	<i>Portunus depurator</i> , Linn.	=οἱ καρκίνοι οἱ μικροί (De Part. iv. 8).
		? <i>Cancer pagurus</i> , Linn.	=Πάγουροι.
		<i>Thelphusa fluviatilis</i> , Latr.	=οἱ καρκίνοι οἱ ποτά- μιοι.
		<i>Pinnotheres veterum</i> .	=πιννοφύλαξ.
		? <i>Maia Squinado</i> .	=μαῖα.
		?	=Ἡρακλεωτικοί.
		<i>Ocypoda cursor</i> .	=Ἰππεύς.
Anomura.	Fam. Pterygura.	<i>Eupagurus Bernhardus</i> , Brandt.	=τὸ καρκίνιον τὸ τῶν στρόμβων.
		<i>Diogenes varians</i> , Costa.	=τὸ τῶν νηρίτων.
Macrura.	Fam. Loricata.	? <i>Scyllarus</i> .	} =κάραβος.
		<i>Palinurus vulgaris</i> .	
	?Fam. Thalassinidæ.	.....	} =ἀστακός.
	Fam. Astacidæ.	<i>Homarus vulgaris</i> .	
		? <i>Nephrops norvegicus</i> .	
		<i>Astacus</i> , fluviatile form.	=οἱ ἀστακοὶ οἱ ποτά- μιοι.
	Fam. Caridæ.	<i>Crangon vulgaris</i> .	=ἡ καρίς ἡ κυφή.
		? <i>Palæmon squilla</i>	} =ἡ καρίς ἡ κυφή.
		? <i>Penæus caraimote</i>	
		? <i>Stenopus spinosus</i>	
		?	=τὸ καρίδιον.
Anomobranchiata.	Fam. Squillidæ	<i>Squilla mantis</i> .	=ἡ κράγγων.
Incertæ sedis	.....	{ ?	=οἱ ἄρκτοι.
		{ ?	=ὁ κύλλαρος.

XXVIII.—On *Merona*, an undescribed Genus of British Hydrozoa.
By the Rev. ALFRED MERLE NORMAN, M.A.

Class HYDROZOA.

Fam. Clavidæ (Allman).

Genus MERONA *, nov. gen.

Trophosome.—Cœnosarc consisting of erect or semierect simple tubes, which arise at intervals from a creeping, filiform

* Nomen arbitrium proprie assignatum.

hydrorhiza, the whole invested by a chitinous periderm. Polypites issuing from the distal extremity of the tubes, claviform, with scattered filiform tentacula.

Gonosome.—Gonophores consisting of mulberry-like masses of sporosacs supported on short gonoblastidia, which arise from short tubular openings in the hydrorhiza.

Merona Cornucopiæ, Norman (species typica).

Tubiclava Cornucopiæ, Norman, Ann. Nat. Hist. ser. 3. vol. xiii. p. 82, pl. 9. figs. 4 & 5.

In the 'Annals' for January 1864 I described and figured a Hydrozoon from Shetland under the name of *Tubiclava Cornucopiæ*. The species was thus assigned by me to a genus which had been recently established by Professor Allman, because it agreed in all essential particulars with the type-species *T. lucerna*, except that the gonophores in *T. lucerna* were described as "dense clusters of sporosacs aggregated immediately behind the posterior tentacula," but in *T. Cornucopiæ* they are dense clusters of sporosacs aggregated on short gonoblastidia arising from the hydrorhiza. It then appeared—and, indeed, still appears—to me questionable whether the exact position of the gonophores is a sufficient ground on which to establish a genus. I therefore thought it desirable that the generic character of *Tubiclava* should be extended so as to embrace the new form which I had met with. Professor Allman, however, prefers to retain his genus within the limits originally assigned to it, and, both by letter and in his paper "On the Construction and Limitation of Genera among the Hydroida" (Ann. Nat. Hist. ser. 3. vol. xiii. p. 345), has given it as his opinion that my *T. Cornucopiæ* is the type of a new genus, which is here therefore established under the name *Merona*.

Houghton-le-Spring,
March 13, 1865.

XXIX.—*On the Muscular Mechanism of the Leg of the Ostrich.*

By the REV. SAMUEL HAUGHTON, M.D., F.R.S., Fellow of Trinity College, Dublin.

[Plates VI. & VII.]

ON the occasion of the death of the fine male Ostrich during the month of January 1864, in the Zoological Gardens of Dublin, I secured the body for dissection in Trinity College, and requested Mr. Macalister, of the Royal College of Surgeons, to avail himself of the opportunity thus afforded of completing the anatomical investigations he had previously commenced, in the Royal Dublin Society, by the dissection of the female Ostrich

in the summer of 1863. Mr. Macalister availed himself of the opportunity, and has laid before the Royal Irish Academy such results of his dissections as seemed to him most worthy of record.

My own attention was directed especially to the investigation of the muscular mechanism of the leg of the Ostrich, which I have long regarded as one of the most interesting pieces of mechanism in the animal kingdom. I was fortunate enough to discover, in the digastric rectus femoris muscle, what I believe to be the key to the explanation of the complicated muscular apparatus of the Ostrich's leg.

The leg of the Ostrich is to be regarded as a long rod bent at four distinct points, which attains its greatest amount of shortening or bending at the moment the foot touches the ground, and which is suddenly straightened or elongated by the simultaneous contraction of all the muscles. The effect of the sudden elongation of the leg is to throw the whole body of the bird forward, as if from a catapult, from the point of support of the foot; and while the body of the animal is thus projected through the air, the antagonist muscles that flex the several joints come into play, and are assisted in their action by some very remarkable contrivances in the heel-joint, which I shall describe and figure.

It is necessary to the perfection of the mechanism that the greatest possible amount of muscular force shall be expended in straightening or unbending the legs, alternately projecting the animal from foot to foot along the ground, the leg being at its maximum of flexure at the moment of touching the ground, and at its maximum of elongation at the moment of leaving it; and also that the minimum possible amount of force shall be expended in flexing each leg preparatory to its next spring, which must take place on its next touching the ground.

I shall show that the leg of the Ostrich fulfils these two conditions of perfect mechanism; but, before doing so, I shall describe in detail the muscles employed by the Ostrich in the act of running.

Part I. *Description of the Muscles.*

1. A muscle, which must be regarded as a combined tensor vaginæ femoris, glutæus maximus, and agitator caudæ, takes its origin from the whole length of the posterior edge of the ilium (and first two caudal vertebræ) forwards to the commencement of the symphysis iliaca (Pl. VI. fig. I.), and is inserted as follows:—(a) The tensor vaginæ portion is inserted into a broad tendon, passing over the outer side of the knee, this tendon forming also one of the origins of the gastrocnemius. (b) The gluteal portion of the muscle is inserted partly like (a), and

partly by a muscular slip into the middle of the vastus externus. (c) The caudal portion of this muscle is inserted into the posterior border of the tendon (a), near the knee. The weight of the whole muscle is $46\frac{3}{4}$ oz.

2. The glutæus medius has the origin marked in fig. I., on the surface of the ilium, and is inserted in the small pit on the outside of the head of the femur (Pl. VII. fig. II.), and rather behind. Its weight is $13\frac{1}{4}$ oz.

3. The glutæus minimus in the Ostrich is correctly so named, for it is a very small muscle; it arises from a thin line on the ilium, $1\frac{3}{4}$ inch in length, shown in fig. I., just behind the origin of the iliacus, and is inserted, with the opponens quadrato femoris, below the great trochanter, on the front of the femur (fig. II.). Its weight is 1 oz.

4. The biceps femoris has a bony origin below that of the glutæus maximus on the ilium, and lies along the entire surface of the bone, between that muscle and the semimembranosus (fig. I.); it is inserted into the tubercle in the middle of the fibula (fig. V.). Its weight is $41\frac{1}{4}$ oz.

5. The semitendinosus takes its origin from the bony prominence of the posterior extremity of the ilium, from the tuber ischii and the membrane that joins these two points (fig. I.), and is inserted into the inner margin of the upper and posterior surface of the tibia. Its weight is 14 oz.

A remarkable accessory muscle arises from the insertion of the adductor magnus (fig. II.) in the femur, and is fastened into the tendon of the semitendinosus near its insertion into the tibia; this accessory muscle weighs 1 oz., and runs nearly at right angles to the tendon of the semitendinosus. Its action is to lift and guide the tendon, so as to increase the force of the semitendinosus in propelling the body forwards when the foot is fixed. The mechanical use of this muscle is similar to that of the accessorius flexori digitorum longo in the sole of the human foot.

6. The semimembranosus has its origin on the ilium, below the biceps, as shown in fig. I., and it is inserted in a line commencing at the top of the linea aspera of the femur (figs. II., III.), and extending to the fascia of the thigh down as far as the inner side of the knee. Its weight is 17 oz.

The similarity of its use to that of the glutæus (1) is shown by the circumstance that it sends a slip ($1\frac{1}{2}$ oz.) backwards to the sides of the first two or three caudal vertebræ, which must be regarded as an additional agitator caudæ.

7, 8. The vastus externus is composed of two parts:—(1) having an inverted T-shaped origin from the great trochanter, between the insertions of the glutæus medius and minimus (fig. II.); it is

inserted on the outer side of the capsule of the knee-joint. Its weight is $25\frac{1}{2}$ oz. Its action is to the outside of the plane that coincides with the greatest diameter of the highly elliptical cross section of the femur. (2) arises from the whole outer surface of the femur (fig. II.); it has an insertion similar to that of (1). Its weight is 5 oz.

9, 10. The vastus internus, like the preceding, is composed of two parts, whose origins are shown in fig. III. (1) arises from the upper and inner surface of the femur, and is inserted into the inner side of the head of the tibia, into the inner edge of the patella and of the ligamentum patellæ. Its weight is $13\frac{1}{2}$ oz. (2) arises from the lower portion of the inner surface of the femur, and is inserted into the tendon of the former, (1). Its weight is $3\frac{3}{4}$ oz.

The resultant plane of these two muscles lies as much to the inside of the plane of maximum strength of the femur as that of the vasti externi lies to the outer side of the same plane.

11. M. cruræus. Its origin, which lies altogether on the inner side of the femur, is shown in fig. III. It is inserted, without a tendon, into the patella. Its weight is $7\frac{1}{4}$ oz. Its plane of moment coincides very nearly with that of the vasti interni just described; and it is almost impossible to avoid coming to the conclusion that the peculiar elliptical cross section of the femur and its longitudinal plane of maximum strength are contrived with reference to the strains of these muscles, so as to enable the slight and delicate structure of the femur (peculiar to all birds) to resist the action of the forces brought to bear upon it, and which exceed in magnitude those acting on the limbs of most quadrupeds.

12. The rectus femoris muscle is not correctly described in any book that I have seen; and its true nature and connexion with the muscles of the calf were discovered by me quite accidentally. I had taken it for granted that the rectus femoris terminated in the patella; but, as there were two patellas, I wished to know in which of them the muscle terminated. On dissection, to my surprise I found that, instead of ending in either patella, its tendon passed in a groove over and between them both, and, turning outwards and backwards into the calf of the leg, became provided with a second muscular belly, which formed one of the portions of the flexor magnus digitorum, the conjoined tendon of which passed under the heel and terminated in the plantar surface of the toe.

The rectus femoris, with its tendon, is therefore truly a digastric muscle, upwards of 5 feet in length (fig. IV.), and has its origin in the anterior bony prominence of the ilium (fig. I.), which is well marked on every pelvis of the Ostrich that I have

seen. The weight of the fleshy belly of the rectus femoris proper is $7\frac{1}{4}$ oz.

13. *M. sartorius*. This important and remarkable muscle arises from the anterior portion of the ilium (fig. I.), and from some of the spines of the lumbar vertebræ, and, passing in the usual manner across the inner aspect of the thigh, is inserted into the inner side of the ligamentum patellæ and into the top of the tibia. Its weight is 18 oz.

14. *M. iliacus* has a lozenge-shaped origin on the anterior portion of the ilium, between the opponens quadrato femoris and glutæus minimus (fig. I.). Its insertion into the femur is shown in fig. III., at a point which must be supposed to represent the lesser trochanter. Its weight is $1\frac{3}{4}$ oz.

15. *M. gracilis* arises, like the semitendinosus, from the tuber ischii and from the lower half of the ligament joining it to the posterior spine of the ilium, and is inserted into the fascia of the inner side of the knee-joint. Its weight is $4\frac{1}{2}$ oz.

16. *M. adductor magnus* arises from the anterior half of the ischial line (fig. I.), and is inserted into the upper margin of the condyloid pit at the back and inner side of the femur (fig. II.). Its weight is $4\frac{3}{4}$ oz. Its fibres were pale and fatty in the specimen dissected by me.

17. *M. pectinæus* arises from the pectineal point (fig. I.), is inserted into the tibia on the inner side of the knee, and is intimately connected by muscular fibres with the vastus internus (2). Its weight is 4 oz. The blending of the fibres of this muscle with those of the vastus internus, a portion of which, like this muscle, terminates directly in the tibia, is not to be forgotten in considering the mechanical action of the muscles on the hip- and knee-joints.

18. *M. quadratus femoris* has an origin on the ischial line just below that of the adductor magnus, and an insertion, of a linear shape, in the back of the upper portion of the femur, shown in fig. II. Its weight is $2\frac{3}{4}$ oz.

19. *M. opponens quadrato femoris*. This muscle I have so named because it is met with in many animals as the direct opponent of the quadratus femoris. In the muscular systems of the Ostrich and Lion this antagonism between the muscles is very striking. It is found occasionally in human subjects, and is described by Harrison under the name of *M. ilio-capsularis*. While we had the Ostrich in the dissecting-room of Trinity College, a human subject was brought in, which had the ilio-capsular muscle fully developed; and my attention was called to it by Dr. Bennett.

In the Ostrich the *M. opponens* has an origin on the anterior surface of the ilium, between those of the *Mm. sartorius, rectus,*

iliacus, and glutæus medius, as shown in fig. I., and is inserted in the anterior ridge at the base of the great trochanter, with the *M. glutæus minimus* (fig. II.), with the fibres of which it is connected. It weighs $1\frac{3}{4}$ oz.

20. *M. obturator*. In the Ostrich, as in most birds, the internal and external obturator muscles are united, arising from both the inside and the outside of the bony circumference of the obturator foramen, and from both sides of the obturator membrane; their common tendon passes through the lesser ischiadic notch, which forms a pulley, changing the direction of the force through 90° , and receives, on emerging from the notch, the fibres of the little gemelli (fig. I.), placed at each side, anterior and posterior, to guide the obturator tendon to its insertion (fig. II.) on the outer part of the top of the femur. It weighs $17\frac{1}{2}$ oz.

21, 22. *MM. gemelli* weigh $\frac{1}{4}$ oz.

23. *M. coraco-clavicularis*. In the wing of the Ostrich there is a very remarkable muscle, which arises from the bony margin of the coraco-clavicular foramen. This foramen corresponds, in the upper extremity, with the ischiado-pubic or obturator foramen of the lower extremity; and this muscle, passing under a strap-ligament on the shoulder, to be inserted in the outer part of the great tuberosity of the humerus, corresponds with the obturator muscle of the leg.

I consider this muscle to be the second pectoral of ordinary birds, and to be the proper levator humeri. It is usually placed between the first and third pectorals, on the sternum, and lifts the wing by means of a pulley which changes its direction through 135° . This contrivance is necessary in birds of flight, in which it is of as much importance to stow the weight aft as it is in ships to place the fore mast well forward; but as the Ostrich is a running bird, the Divine Contriver has left his second pectoral to lift the humerus by a direct pull, without expending any ingenuity on pulleys to change its direction, as is absolutely necessary in birds of powerful flight, such as the Falcon, in which the pulley of the second pectoral is as remarkable a contrivance as the pulley of the obturator muscle in the Ostrich.

In fact, throughout the whole range of the muscular mechanism of various animals, every pulley changing the direction of an original force presents a problem to be solved, and tells of a Contriving Mind, which has deviated, for some purpose discoverable by us, from the simple contrivance of muscular fibres pulling directly from their origin to their insertion.

24. *M. gastrocnemido-solæus*. This great muscle has four distinct heads:—(a) from the outer side of the patella and of the ligamentum patellæ; (b) from the external condyle of the femur (fig. II.); (c) from the condyloid pit of the inner condyle,

between the adductor magnus and flexor digitorum (fig. II.); (*d*) from the tubercle of the tibia, at both sides, and from the surface of the lower patella, and, by means of a fascia, to the upper part of the fibula. Altogether it weighs $115\frac{1}{2}$ oz.

This enormous mass of muscles represents the gastrocnemius and solæus, intimately connected in their fleshy portion, but distinct both in origin and insertion. It is inserted, as shown in fig. V., by means of two powerful tendons, into the upper and back part of the metatarsus, the tendon of the solæus being a little above that of the gastrocnemius.

It may be regarded as acting from the circumference of a ring placed all round the knee-joint, to the tendo Achillis; and its resultant pull is nearly in the axis of the leg.

25. MM. flexores digitorum. These important muscles may, in the Ostrich, be divided into two distinct groups. A. This group arises from a triple origin:—(*a*) the condyloid pit of the femur, below the origin of the gastrocnemius (fig. II.); (*b*) from the outer side of the outer condyle of the femur (fig. II.); (*c*) a fleshy slip connects these flexors with the belly of the digastric rectus femoris in the calf of the leg. This slip is represented, cut off at the point *o*, in fig. IV. Their total weight is 16 oz. B. This group has a double origin:—(*a*) from the condyloid pit of the femur; (*b*) from the whole back of the fibula and tibia, except the part covered by the poplitæus. Their weight is $9\frac{3}{4}$ oz.

26. M. tibialis anticus. This is a flexor of the metacarpus, and arises from the two anterior tubercles of the tibia and from the outer side of the external condyle of the femur (fig. III.). It is inserted below the heel-joint, by means of a split tendon, into the front of the cannon bone, two inches below the joint (fig. V.). Its weight is $8\frac{3}{4}$ oz.

27. M. extensor digitorum communis (fig. V.). This muscle takes a fleshy origin from the tubercles of the tibia and from the crest in front of the tibia. It is inserted into the toes and into the annular ligament of the phalangeal joints. It has no action in flexing the cannon bone, except perhaps in some unusual position of the foot. Its weight is $5\frac{1}{4}$ oz.

28. M. poplitæus. Well marked, and rotates the fibula on the tibia. $\frac{3}{4}$ oz.

Part II. Action of the Muscles.

In the act of running, the leg of the Ostrich is to be regarded as a jointed lever, having four joints, viz. the hip, the knee, the heel, and the metatarsal joints. As the animal springs from foot to foot, the whole limb, on reaching the ground, is bent as far as possible at each of these articulations; and, as the spring is made, the muscles proper to each joint increase the angle

made by the bones meeting at the joint, so that the effect of the whole is to unbend the limb and give it a maximum of extension at the moment of leaving the ground. During the spring, the antagonist muscles again bend the joints, so that on next touching the ground it is at its maximum of flexion, again waiting to be unbent by the muscles that open the angles of the joint, and so on; as long as the animal runs, it is thrown alternately from each foot in contact with the ground as from a catapult, and advances by successive leaps or springs from foot to foot.

To take mathematical account of the moments of the muscular forces round each joint, it would be necessary to make the following measurements:—

Let the points O and I be the origin and insertion of any muscle, and A the centre of motion of the joint. The effect of the contraction of the muscle is to develop a moment or couple round the point A, acting in the plane O A I, and proportional to the weight of the given muscle. If it be required to find the total effect of the muscles acting on a given joint with respect to any line A X, we should have to find the angle made by each plane of moment O A I with the line A X, and so calculate, by the usual rule of composition of moments, the total effect of all the forces acting and tending to produce rotation. Without going into minute detail, and taking only the muscles that act perpendicularly, or nearly so, to the transverse horizontal axis, we find the following muscles to represent the moment of the spring forwards:—

1. *Muscles extending the Femur on the Axis of the Body.*

1. Tensor vaginæ femoris	}	oz.
2. Glutæus maximus		
3. Agitator caudæ		
4. Biceps femoris		46·75
5. Semimembranosus		41·25
6. Semitendinosus		17·00
7. Gracilis		14·00
8. Adductor magnus		4·50
9. Pectinæus		4·75
		4·00
		<hr/>
		132·25

2. *Muscles extending the Leg on the Femur.*

10. Rectus femoris		7·25
11. Vastus externus (1)		25·25
12. „ „ (2)		5·00
13. Vastus internus (1)		13·50
14. „ „ (2)		3·75
15. Cruræus		7·25
		<hr/>
		62·00

3. *Muscles extending the Metatarsus, or Cannon Bone, on the Leg.*

	oz.
16. Solæo-gastrocnemius	115.50
17. Flexores digitorum (A).....	16.00
18. „ „ (B).....	9.75
	<hr/>
	141.25

The total combined effect of these muscles projecting the body forwards is therefore approximately represented by 335.50 oz. of Ostrich-muscle*.

After the foot of the Ostrich has left the ground, and during his spring through the air, the following muscles are employed in flexing the several joints, so as to have them in readiness for another spring as soon as the foot touches the ground.

1. *Muscles flexing the Thigh upon the Axis of the Body.*

1. Sartorius	18.00
2. Iliacus	1.75

The flexure of the leg upon the thigh seems to be effected by the *vis inertiae* of the former when the latter is drawn up towards the body, in the spring.

2. *Muscles flexing the Cannon Bone upon the Leg.*

3. Tibialis anticus	8.75
4. Extensor digitorum communis	5.25

14.00

* If we knew the weight of the Ostrich, and the length to which it can spring in a single maximum stride, we could easily calculate the work done in a single effort by a given weight of Ostrich-muscle. I do not know how far an Ostrich in a state of nature can spring, nor how high, and am therefore unable to make the required calculation; but I give here two corresponding problems for man, which may be interesting to the physiologist.

Problem 1. A cricket-ball, weighing $5\frac{1}{2}$ oz., is thrown a distance of 91 yards; find the work done by the muscles.

The thrower, by practice, finds the angle of maximum range, or 45° ; and as

$$R = 2h \sin 2e$$

for the maximum range, h , the height due to the velocity of projection, is found to be 136.5 feet. This is the height to which $5\frac{1}{2}$ oz. are raised; and therefore the work done is found to be 46.92 lbs. lifted through 1 foot.

Problem 2. A young man, weighing 120 lbs., leaps horizontally 20 feet; what is the work done? By the same method of calculating, we find the work done, in this case, to be 1200 lbs. lifted through 1 foot. This large amount of work is not given out in a single spring; for it represents the sum-total of the single spring and of the velocity acquired in running up to the point of starting; and the whole art of long jumps resolves itself into jumping vertically with a velocity equal to the acquired horizontal velocity, and making both quantities a maximum.

From this it would appear that the moments of the muscles flexing the joints of the limb during the spring are represented by 33·75 oz.

This is a small amount of force compared with that employed in extension and in propelling the body forwards; but the flexor muscles are aided by inertia and by a special contrivance in the heel-joint that remains to be described.

The articulating surfaces of the bottom of the tibia and top of the metatarsus or cannon bone are so formed that it is easier to flex the joint forwards than backwards; and this natural disposition of the joint is further aided by two admirably contrived check ligaments, shown in figs. VI., VII., which render the motion forwards much easier than that backwards.

In fig. VI. I have shown the tendons of *M. gastrocnemius* and *M. solæus*, and in fig. VII. the tendons of the *flexores digitorum communes*, passing under and through the tendon of *M. gastrocnemius*.

In fig. VI. are also shown the tendons of *M. tibialis anticus* and *M. extensor digitorum communis* passing through a common "dead-eye" bolt at A—a contrivance necessary to keep them in their place on the flexure of the heel-joint, and corresponding with the annular ligament of the human foot. In consequence of the arrangements just described, the foot of the Ostrich is jerked forward suddenly, after passing a position of unstable equilibrium, or "dead-point," as it is called by mechanical engineers, and is slowly drawn backwards beyond that point by the action of the powerful extensors of the joint when they are employed in making a spring.

Any observer who examines the gait of the Ostrich, Emu, Cassowary, or Rhea, in confinement, cannot fail to be struck with the ungainly effect produced, on the appearance of the animal, when walking slowly, by the abrupt and odd-looking lifting of the foot, caused by the structure of the heel-joint, giving an effect like that of "string-halt" in horses; but this unpleasing impression would be rapidly converted into admiration if he could see the bird in rapid motion over rough ground, springing from foot to foot, and bending with the rapidity of lightning the foot as it left the ground, avoiding skilfully and without an apparent effort the dangers of the rough soil. I have been informed by eye-witnesses that, under such circumstances, the Ostrich in South Africa almost touches the ground with its body alternately on each side, in every successive spring, and leaps with ease over rocks and shrubs of moderate dimensions that lie in its onward path.

I have shown, in the preceding part of this paper, that the force expended in propelling the body of the Ostrich forward is

ten times the force employed in restoring the legs of the animal preparatory to its next spring—more exactly, as 335·5 to 33·75. This enormous force acts on bony supports which are required, by the necessities of a bird's existence, to be as delicate and light as possible; and it is, moreover, exerted almost instantaneously, so as to give the fullest effect to the bird's spring. The question naturally arises, How is this force to be suddenly applied, without breaking or dislocating the animal's leg?

The answer to this question is to be found in the peculiar structure of the rectus femoris muscle, which binds down the patellæ, straps up the heel, and brings the whole machine into harmony at the moment that the spring is about to take place.

The admirable mechanical economy of the leg of the Ostrich may be illustrated by the parallel case of the Cornish pumping-engine. Let us suppose a 100-inch cylinder engine about to commence its downward stroke, and to lift the pump-rods, weighing many tons, by means of a force of steam which commences at a maximum and is gradually let off by expansion to a safe and manageable quantity. It has been found by experience that it is necessary to cause a minute vibration of the beam before letting on the full force of the steam, such vibration shaking all the nuts and pins into their proper positions before the great and sudden action of all the parts takes place; and if such a precaution were to be omitted, it is well known that the sudden impulse of the steam would break the engine.

In the leg of the Ostrich the rectus femoris muscle supplies the place of the preliminary vibration; it acts before the extensor muscles come into full play; it binds down the two patellæ, braces up the heel-joint, and gives the signal for the gastrocnemio-solæus and other associated muscles to contract, and thus produces what may be regarded as one of the most striking phenomena in nature—viz. that the delicate bones and ligaments of a bird's leg, acted on by muscles equal to those influencing the hind leg of a horse, shall remain uninjured under the sudden action of forces the slightest error in the application of which would break to pieces the machine on which they act.

I can admire, though I do not envy, the reasoning powers of those naturalists who can believe that a mechanism such as this grew out of preexisting forms, without the direct interposition of an Intelligent Mind; and for myself I must declare that I could as easily believe that the modern Cornish engine had developed itself from its clumsy predecessors by the way of Natural Law, and without the interposition of intelligent engineers, as that the leg of the Ostrich was produced by Natural Selection from the common-place legs of its less perfect ancestors.

XXX.—On the Corals of the Maltese Miocene.
By P. MARTIN DUNCAN, M.B. Lond., Sec. Geol. Soc.

[Plate XI.]

THE Corals discovered in the strata in the island of Malta are generally badly preserved. Either they are found as casts or are so filled with a ferruginous mineral as to be indeterminable. The few which are well preserved offer some points of interest, and add to the palæontological data upon which the geological age of the whole series of strata is determined.

MM. Milne-Edwards and Jules Haime have described two species from the island, but have not mentioned the bed whence they were derived—the *Acanthocyathus Hastingsiæ*, Ed. & Haime, and the *Heliastrea Prevostana*, Ed. & Haime*. The second species is founded on a badly preserved coral of the genus *Astræa* (now termed *Heliastrea* by those able zoophytologists); and its specific characters are not sufficiently given to be comprehended. But it is not amongst the collection about to be described.

Following Dr. Adams's† last classification of the Maltese strata, and arranging the Corals under their respective beds, the species are thus distributed:—

1. The Coralline Limestone (uppermost stratum).

Astræa (*Heliastrea*) *Ellisiana*, DeFrance. Other localities, Miocene of Dax, Turin, Crete, &c.

Astræa (*Heliastrea*) *Forbesi*, sp. nov. Allied to the Miocene *A. Barbadosensis*, nobis.

2. The Yellow Sand.

Stephanophyllia imperialis, Michelin. Astesan Tertiaries.

Flabellum extensum, Michelin. Miocene of Turin, Villeneuve-lez-Avignon, Antwerp.

Cænocyathus Adamsi, sp. nov. Allied to recent species in the Mediterranean.

Acanthocyathus Hastingsiæ, Ed. & Haime. (?)

3. The Clay-bed.

Stephanophyllia imperialis, Michelin.

4. The Calcareous Sandstone.

Cænocyathus, sp.

* Hist. Nat. des Corall. vol. ii. pp. 22 & 478.

† See various papers by Drs. Wright and Adams on the Echinodermata of these strata in Quart. Journ. Geol. Soc., and by Prof. R. Jones and myself in Geol. Mag. No. 3, 1864.

5. The hard Cherty Limestone.

Stylocœnia lobatorotundata, Michelin, sp. Miocene of Rivalba, Turin, Verona, Antiguan chert.

Dendrophyllia irregularis, Blainville. Miocene of Dax.

Porites incrustans, Defrance, sp. Miocene of Turin, Dax, Trinidad, San Domingo.

Astræa (*Heliastrea*), sp., in large casts. Clearly a Miocene form.

The specimens were sent to me by Dr. Leith Adams, having been marked with the number of the beds whence they were derived. Doubtless many other species will be found.

Cœnocyathus Adamsi, n. sp. Pl. XI. fig. 1.

A corallite broken off from the parent corallum presents an ovoid mark of fracture, which is larger than the cylindrical pedicel immediately above it. The corallite is tall, nearly straight, and cylindrico-conical. The calice is not quite circular, is very open, shallow, and characterized by the prominent transversely ridged columella. The wall is stout, is marked by faint costal projections for a short distance from the calice, but is, with these, covered by a finely granular epitheca, which is marked by some aborted buds. The septa in six systems of four cycles; the primary and secondary are equal, and extend to the columella, but the primary are the most exsert; the tertiary are larger than those of the fourth cycle. The laminæ are stoutest at the wall, are arched, and some become wavy near the columella; they are marked by sparse rows of granules. The pali, which are on the primary and secondary septa, are very small and indistinct.

Height of corallite 1 inch; width of calice $\frac{9}{10}$ inch.

This species is determined by the great development of the columella and the smallness of the pali; and it has but a very remote affinity with *C. costulatus*, Reuss (Oligocene). The recent species, which are all Mediterranean, are equally remote.

Locality, Bed 2 (Adams), Malta. Coll. Geol. Soc.

Astræa (*Heliastrea*) *Forbesi*, n. sp. Pl. XI. fig. 2.

The corallum is large, often covers a large space, and presents a very uneven calicular surface. The growth of the corallites appears to have been more or less intermittent in some specimens, where the cœnenchyma exists at certain heights alone. The corallites in the larger specimens are nearly parallel and nearly cylindrical, and they vary in size somewhat; usually they are close, but not crowded; and in certain spots on luxuriant specimens they are evidently separated by some cœnenchyma. The calices are circular in outline, are slightly and irregularly ele-

vated above the intercalicular spaces, and are well open. The wall is well developed; its calicular margin is blunt, and it is marked externally by fine and distinct costæ. The calicular fossa is not deep; but the shallow fossæ of worn specimens are deceptive. The septa, in six systems of three cycles, are very delicate, not crowded, thin, slightly exsert, dentate, and unequal; the primary (the largest) extend to the columella; they have a small paliform tooth, and they are slightly thicker at the wall than elsewhere (in many specimens, owing to the form of fossilization, they are stout and are largest at the columella and wall). The secondary septa are smaller than the primary, but larger than the tertiary; they are thinner, and do not reach the columella; the tertiary project from the wall, and now and then curve towards the secondary. All are perforated occasionally, and are very fragile and granular. The costæ are slightly inclined at the calice, faintly dentate, and subequal, there not being that difference between them which there is between the septa; on the wall they project as thin laminæ with an irregular margin, and usually touch those of other corallites. The columella is feebly developed, and, in some corallites, barely exists; but, as a rule, it is small, distinct, and projects at the bottom of the fossa: it is parietal. The endotheca is very scanty. The exotheca is sparsely developed. The cœnenchyma exists in some spots, and is cellular; but it is by no means strongly developed.

Height of corallites $\frac{8}{10}$ — $\frac{15}{10}$ inch; width of calices $\frac{1}{10}$ — $\frac{1}{6}$ inch.

This Coral presents several varieties.

Var. 1, with deeper calices than the type.

„ 2, with the primary costæ larger than those of the type.

„ 3, with smaller calices

„ 4, with wider-apart calices } than those of the type.

The calcareous fossilization of this species alters the appearance of many specimens; in general, all the hard textures are thicker than those of the type, consequently the septa, wall, and costæ are larger, moreover their details are worn off. The best specimens are often intermingled with portions containing casts; and when this is the case, the interspaces are solid; but the original sclerenchyma has been destroyed, leaving vacant spaces.

The species is more closely allied to *Astræa* (*Heliastrea*) *Barbadensis*, nobis*, and to *Astræa* (*Heliastrea*) *annularis*, Ellis and Solander, sp., than to any others. The first is from the Barbadian marl; and the last is a recent species, probably from Oceania. The wide-apart calices and well-developed columella of *Astræa* (*Heliastrea*) *Raulini*†, Ed. & Haime, form a specific

* Duncan, "West Indian Fossil Corals," Quart. Journ. Geol. Soc. vol. xix.

† Milne-Edwards and Jules Haime, Hist. Nat. des Corall. vol. ii. p. 474.

distinction; and the new species cannot be the *Astræa* (*Heli-astræa*) *Prevostana*, Ed. & Haime*, which only differs from *A. Raulini* by its closer calices, thicker walls, and less developed costæ. The columella is well developed in this last species, if it be like *A. Raulini*. MM. Milne-Edwards and J. Haime do not figure or positively describe their "unique échantillon" "en assez mauvais état."

Locality, Bed No. 1 (Adams), Malta. Coll. Geol. Soc.

EXPLANATION OF PLATE XI.

- Fig. 1.* *a*, corallite of *Cænocyathus Adamsi*; *b*, its calice, magnified 2 diameters.
Fig. 2. *a*, corallum of *Heliastrea Forbesi*, natural size; *b*, usual appearance of badly preserved specimens; *c*, calices, natural size; *d*, calices, magnified 4 diameters; *e*, monstrous calice with seven systems, magnified 4 diameters; *f*, calice without a columella, magnified 4 diameters.

XXXI.—Description of a new Genus of Amphipod Crustacea.

By Dr. FRITZ MÜLLER.

[Plate X.]

BATEA, nov. gen.

Antennæ simple. Coxæ of the first pair of gnathopoda rudimentary, those of the second pair of gnathopoda and the first two pairs of pereopoda largely developed. Coxæ of the second pair of pereopoda deeply excavated upon the upper part of the posterior margin. First pair of gnathopoda rudimentary, consisting of coxa and basis only; second pair of gnathopoda subchelate. Mandibles having an articulated appendage. Maxillipeds having a squamiform plate on both the basis and ischium joints. Fourth and fifth pairs of pleopoda with styli-form rami, sixth pair with subfoliaceous rami. Telson single, deeply cleft.

Species *Batea catharinensis*, F. M.

I will here add some remarks on the sexual differences of this interesting species. The pereion is somewhat longer and higher in the female; the antennæ of the same are shorter. The first joint of the peduncle of the upper antennæ has three, the second four, fasciculi of hairs on the inferior side in the male; they are wanting in the female. The long setæ at the extremity of the alternate articles of the flagellum of the first antennæ are directed downwards in the female, backwards in the male. The third and fourth joints of the peduncle of the lower antennæ have fasciculi

* *Op. cit.* vol. ii. p. 475.

of short hairs on their upper sides in the male, which are wanting in the female. (The eyes are larger in the male.) The flagellum of the lower antennæ has long upward-directed setæ at the extremities of alternate joints in the female, which do not exist in the male. The first pair of gnathopoda are shorter in the male, with but few hairs near the top; they are as long as the basis of the second pair of gnathopoda in the female, slender, flexible, with long hairs on the anterior margin, and shorter curved hairs at the distal extremity. The coxæ of the second pair of gnathopoda are much higher in the female. The first two pairs of pereopoda have the carpus and propodus fringed with long hairs at the posterior margin; these hairs are wanting in the female.

Desterro, Brazil, Oct. 10, 1864.

EXPLANATION OF PLATE X.

Fig. 1. *Batea catharinensis*, male: *b*, superior antennæ; *g*, maxilliped; *h*, first gnathopod; *h*¹, coxa; *h*², basis; *i*, second gnathopod; *q*, second pleopod; *r*, third ditto; *s*, fourth ditto; *t*, fifth ditto; *v*, posterior pleopod; *z*, telson.

XXXII.—On the Fresh- and Salt-water Rhizopoda of England and India. By H. J. CARTER, F.R.S. &c.

[Continued from vol. xiii. p. 36.]

[Plate XII.]

IN my last communication on the Rhizopoda of England and India, I ended with the mention of the new genus and species *Acanthocystis turfacea* (Annals, vol. xii. p. 263), the magnified view of the spine of which (vol. xiii. pl. 2. fig. 25 *i*) should not be tapering in the shaft, as therein represented, but of the same size throughout as at the bifid extremity. (See those round the entire figure.) Will the reader be pleased to make the correction?

Just preceding the mention of *Acanthocystis* allusion is made to *Actinophrys oculata* as having been in company with *A. Eichhornii* in "fresh water." This is also a mistake; for I find by my notes that this species was found in another basin, and one which contained salt water. Further, I intimated my intention to write more on *A. oculata* hereafter; so we will now return to it.

Actinophrys oculata, Stein. (Die Infus. tab. v. & Pritchard's Hist. of Infus. pl. 23.) Pl. XII. figs. 1, 2, 3.

I have only seen specimens of this species once, viz. in July

1859, and these abounded in a basin containing water from the main drain of Bombay, which is flooded by the sea at each tide. It is alike remarkable for the eye-like appearance imparted to it by the nucleus, from which its specific name has been derived, and for its gregarious habits. Stein considered that the whole of the light-coloured granular zone, with its contents, constituted the nucleus and nucleolus respectively. I am not certain that the light-coloured zone may not be outside the nucleus, when the inner circle and its contents would become the nucleus and nucleolus respectively. Both appear to consist of fine granular plasma. Stein, however, represents the whole together isolated (*l.c.*) as the nucleus of *A. oculata*, calling the light granular zone the "Marksubstanz." If the latter be within the nucleus, which I think likely, then the nucleus in this state seems to indicate a step towards generative development; but in what the rest of the process may consist, even if this be the case, remains for future observation to show.

The other peculiarity of this species, viz. its gregarious habits, allies it to *Spongilla*, which is but an aggregation of amœbous cells held together by a fine plasma. That of *A. oculata* appears to be derived from the more subtle parts of their ectosarc, since the Actinophryans thus aggregated are not in zygotis, as my figures and Stein's will show, but merely held together in the way described (figs. 1 & 2 *b b*); while stomachal cavities are extemporized in this ectosarc (*c c c*), in which fragments of nutritious matter are enclosed, apparently for the use of the whole community.

This, too, seems to strengthen the view taken that the nucleus is in a generative stage, when it may be advantageous for the *Actinophrys* to have its interior freed from all extraneous matter.

Be this as it may, there are also other cavities in the ectosarc, which contain large, smooth, subrotund, and nearly colourless masses, apparently different in nature from the fragments of crude food mentioned, being more like amylaceous concretions than the latter; but whether these have been incepted, are the remains of crude food, or what their real composition may be, I am ignorant. They also equally characterize Stein's and my own figures of this *Actinophrys* (figs. 1–3 *d d d*).

I did not observe any specimens with contracting vesicles or any other kind of vacuoles in a chain, round the Actinophryans respectively, or in the uniting sarcode, as figured by Stein; but the margins of the Actinophryans were defined by a strongly marked crenulated line, indicating a corrugated superficial layer. Nor have I in any of my sketches represented fragments of crude food *within* the Actinophryans themselves.

With *A. oculata* were associated groups of *A. Sol*, mihi (fig. 3), differing only from those of *A. oculata* in the absence of the nucleus and the strongly marked crenulated outline round the Actinophryans, with less appearance of uniting sarcode, but more of actual zygosis. Their internal contents, too, consisted almost wholly of the characteristic granular sarcode of *Actinophrys*, with complete absence of all vacuoles, even to the contracting vesicle itself—a condition most favourable for seeing the nucleus, if it had been present; but none was detected.

A complete disappearance of the nucleus (termed its “solution”) and its reconstruction are not uncommon. It would seem to occur in duplicative division of the cells of *Spirogyra nitida*, &c. (A. Braun, Bot. and Phys. Memoirs, Ray Society, 1853, p. 241; and Nägeli, foot-note, p. 248); also, under similar circumstances, in the addition of new to the old tubular root-cells of *Chara verticillata* (Annals, vol. xix. p. 13); and latterly its disappearance has been demonstrated and explained in some of the freshwater Rhizopoda themselves, as in all probability connected with impregnative generation (Annals, vol. xix. p. 13).

Hence this form of *Actinophrys* may represent a stage in the generative development of *A. oculata*. But, whether or not, it was abundantly present with *A. oculata*, and will be seen by the figure to be so like it in grouping that I think it may reasonably be assumed to be only another form of this species. Indeed, according to Claparède and Lachmann (Etudes sur les Rhizopodes, p. 45, &c.), these distinguished authors could never see the nucleus in *A. Sol* with certainty, and they add,—“Stein’s *A. oculata* is a marine form; but we have observed in the North Sea myriads of an *Actinophrys* that we did not know how to distinguish clearly from *A. Sol* of the fresh water, and which coincides altogether with the figure given by Stein of his *A. oculata*.” It is not quite evident here how *A. Sol* can “coincide” altogether with Stein’s *A. oculata*, if a nucleus could not be seen in the former. But the authors’ meaning is plain, viz. that they thought *A. Sol* of the North Sea and *A. oculata* to belong to the same species, which harmonizes with what I have just stated respecting this question, and what my figures illustrate.

In the representations which I have given of *A. oculata*, fig. 1 is shaded, while fig. 2 is only an outline of nine individuals in aggregation, with two vacuoles containing each the remains of a rotatory animalcule, and the other the apparently amylaceous body to which I have alluded. In fig. 1 all the tentacles bore drop-like masses of ectosarc along their shafts respectively; but these have only been inserted in those of the Actinophryan *a*,

for the purpose of lessening the trouble of engraving and to avoid confusion in the plate. In the group, fig. 3, the tentacles were smooth, and bore no superfluous portions of sarcodæ; but it will presently be seen, as it has already been shown in the *Actinophryans* figured in my last plate (*l. c.*), and as it will be seen in others in the one illustrating this paper, that the presence of these additional portions of ectosarc (which may assume various forms and positions along the shaft of the tentacle and at its extremity) are but contingencies, and therefore of no specific value, while they strongly evidence the existence of an axial support within.

The *Actinophryans* grouped together were not all of the same size, having varied a little in diameter below the $\frac{1}{450}$ th part of an inch.

In fig. 4, which represents three separate *Actinophryans* sketched on a previous occasion (probably from fresh water), each was surrounded by a peripheral layer of vacuoles (which in the focal disk assumes the form of a chain only), but neither presented any trace of a nucleus in the interior. In *a* the vacuoles of this layer were uniformly small; in *b* they were uniformly large; and in *c* some were large and others small, while the tentacles of the latter only bore the drop-like masses of ectosarc just described. These *Actinophryans* were each about $\frac{1}{415}$ th of an inch in diameter; they were sketched in January 1855, but there is no record of the kind of water, whether salt or fresh, from which they were obtained, although the following specimen (fig. 5), which was $\frac{1}{360}$ th of an inch in diameter, and found in fresh water, is so identical in appearance with the last mentioned, that in all probability, as just stated, the whole came from fresh water. Fig. 5 is chiefly introduced to show that the ectosarc existed on the extremities of the tentacles in little spherical masses, as well as in ovoid ones along their shafts. In its interior some Diatoms were observed, which had been incepted for food, but no nucleus.

It was from observing the last mentioned *Actinophryans* and others like them, that I was led to make the following remarks in my "Notes on the Organization of the Infusoria" (*Annals*, vol. xviii. p. 129, 1856), and which I see have been quoted, but not exactly understood, in the last edition of Pritchard's 'Hist. of Infusoria,' p. 250, as follows:—" *Actinophrys Sol*, Ehr., is surrounded by a peripheral layer of vesicles, which, when fully dilated, appear to be all of the same size, to have the means of communicating with each other, and each, individually, to contract and discharge its contents externally, as occasion may require, although generally one only appears and disappears in the same place." From this I infer that I must have seen these "vesi-

cles" or vacuoles burst and discharge themselves like the ordinary contracting vesicle.

Now, from Stein's having figured a chain of vacuoles round his *Actinophrys oculata*, and my figures of this species being, with this exception, identical with his—while the group fig. 3, although assuming the form of *A. Sol*, has been assumed to be but another form of *A. oculata*, and figs. 4 and 5, which I considered at the time they were sketched, and do now, as *A. Sol*, present a marginal chain of vacuoles similar to those in Stein's figure of *A. oculata*,—it seems to follow, that if all these Actinophryans are not different phases of the same species, the peripheral layer of vacuoles at least is of no specific value, any more than the presence or absence of the drop-like masses of sarcode about the tentacula. I have already quoted a passage from Claparède and Lachmann, in which they identify a species of *Actinophrys* which they found in the North Sea at once with *A. Sol* of the fresh, and Stein's *A. oculata* of the salt water.

With these end the descriptions and figures of all the Actinophryans which came under my notice, from time to time, at Bombay, that seem to me worth publishing. Let us now briefly turn our attention to those which I have found in England.

Plentiful as *A. Eichhornii* seems to be in England, I only met with two large specimens of it in Bombay; and when these were delineated for my last plate on the freshwater Rhizopoda, which was published in January 1864, I had not had an opportunity of studying this species in England.

Just afterwards, however (in December 1863), I accidentally obtained a large supply of it from a pool of fresh water in the neighbourhood of this place (Budleigh-Salterton), and took advantage of the occasion to make the observations and sketches which have enabled me to compile the fragment of the disk represented in Pl. XII. fig. 6. This, for comparison, has been drawn upon the same scale as the other Actinophryans, by which it will be observed that while the diameter of the latter is but half an inch, that of the former is 8 inches, or sixteen times as much, the real diameter of the smaller Actinophryans varying from $\frac{1}{600}$ th to $\frac{1}{300}$ th of an inch, and that of the largest specimens of *A. Eichhornii* being full $\frac{1}{30}$ th of an inch. All have been drawn upon the scale of $\frac{1}{24}$ th to $\frac{1}{5400}$ th of an inch. Thus we are enabled more easily to appreciate their relative differences in point of size.

The fragment, by mistake, was at first drawn upon a radius of eight, instead of one of four inches; but as the error was only in the circle, the latter has been reduced to its proper size, which is all that is required. All the other detail, with the ex-

ception of the trifling discrepancies in the general outline of the fragment, is correct. To have cut the latter down to an exact segment of a four-inch radius would have destroyed the uniformity of the plate, while the reader can easily do this for himself, if necessary.

My object in giving such an enlarged view of a portion of *A. Eichhornii* has not been so much to compare its size or structure with that of the other Actinophryans as to bring into view certain spherical bodies which are situated and apparently developed in the intervacuolar sarcode, since it seems to me that these are as much "reproductive cells" of *Actinophrys* as those which I have figured and called attention to, from time to time, since 1856 up to the present day, in *Spongillæ*, *Amœbæ*, *Euglyphæ*, *Diffugiæ*, and, among the Foraminifera, in the living species *Operculina arabica*, and in fossil *Nummulites*, *Orbitoides*, &c.

So little attention appears to have been paid to these bodies in *Actinophrys Eichhornii*, that, although Kölliker is frequently and justly quoted as an authority on the structure of this species, in the last edition of Pritchard's 'Infusoria' no allusion is made to them beyond that at page 252, where this eminent physiologist is stated to have enumerated among the general contents of the body of *Actinophrys* "some separable nuclear cells;" but whether these be the ones in question or not, the context does not enable me to decide. Latterly, however, Dr. Wallich has undoubtedly described and figured them in his excellent representations of *A. Eichhornii* (Annals, vol. xi. p. 450, pl. 10. figs. 1 & 2 *nn*, 1863), and observes respecting them—"These multiple nuclei are distributed here and there through the protoplasm, each occupying a spherical cavity, which is completely filled up by the granular matter, and quite distinct in outward appearance from the polygonal soap-bubble-like mass of which the rest of the body is constituted." Any one at all conversant with the subject will, with this description, immediately recognize these bodies in my illustration; but whether they be derived from a subdivision of the nucleus, as Dr. Wallich seems to conjecture, or not, is a question to which I shall have to return presently.

With the large specimens were others of all sizes, down to $\frac{1}{400}$ th part of an inch in diameter (fig. 7), and, I dare say, still smaller, if I had had more time to look for them; but all below a certain diameter failed to present the "reproductive cells" mentioned.

For a structural description I shall take one of the largest specimens, and, to avoid all tedious repetition of what has probably been better stated before, confine myself briefly to a sum-

mary of my own observations, chiefly with reference to a more particular account of the supposed "reproductive cells."

Actinophrys Eichhornii, Ehr., mihi.

(Pl. XII. fig. 6: $\frac{1}{30}$ th of an inch in diameter.)

Primary form globular, but slightly altering this according to circumstances. Length and size of tentacles also variable. Body vacuolar in structure; the interstices of the periphery are so much larger than those of the interior that they form a distinct layer over the latter; and this is so defined that the former may be viewed as the ectosarc (*a a a a*), and the internal portion as the endosarc (*c c c c*). "Granules," like those observed in *Amæbæ*, &c., are contained in the vacuoles (*e*), where they have a quivering motion exactly like that presented by similar bodies in the endoplasm of *Spirogyra*, in which this movement appears to be owing to the "irritability" of the plasma in which they are suspended. Indeed, to my knowledge, there are no two plasmata more alike in this respect than those of *Actinophrys* and *Spirogyra*; they are even more so than that of *Actinophrys* and that of the *Desmideæ*. The vacuoles, for the most part, collapse under the effect of iodine, leaving a granular plasma in their place. Tentacula composed of a granular plasma extended outwards from the inner portion or endosarc (*k k*) and receiving a more subtle covering from the ectosarc (*i i*); the former is well seen under the action of iodine, when the tentacula become wavy and contracted. Spaces between the interstices of the endosarc presenting spherical bodies imbedded in the intervacuolar sarcode, the larger ones about $\frac{1}{2000}$ th of an inch in diameter (*d d d*), each filled with a thick plasma containing a group of granules in its centre, and the whole enclosed in a transparent spherical cell (*e*). Below this diameter they appear to vary to a mere point, and the granules and external cell not to be developed until they approach in size that above mentioned (*g g*). Sometimes there are two of the full size in one cell, as if the original one had undergone duplicative division (*h*). Iodine colours their fine contents of a light, and the granules of a deep amber-colour, which again, on the addition of a little dilute sulphuric acid, presents a pink tinge. In a specimen of this *Actinophrys* measuring $\frac{1}{30}$ th of an inch in diameter, I calculated, after the vacuoles had been broken down by iodine, that there were between three and four hundred of the full-sized spherules or spherical bodies. Sometimes they are seen on their way through the ectosarc or cortical portion, and occasionally attached only to the margin by a thin film of the latter, spread over the spherule, and contracted to a delicate pedicel where it is in connexion with the parent. How far this may have been

natural, or induced by pressure of the glass cover, I have not yet been able to decide. In one instance, after a matured spherule had been forced out of the parent, I observed that the transparent cell, which does not exceed it much in size, contained a fine delicate plasma, in the midst of which there was a single vacuole; and I could not help also seeing in this specimen the same elementary composition as that of an *Actinophrys*, viz. a thick endosarc with strongly marked granules, surrounded by a thin ectosarc in which there was a vacuole like a contracting vesicle. Whether that be the body, and these be the elements respectively which afterwards become developed into a young *Actinophrys*, is for future observation to determine. Crude food is incepted by *A. Eichhornii*, and contracting vesicles appear here and there; but I never could detect a nucleus in either the largest or the smallest specimens (fig. 7) that I have had under my observation.

It is true that, in the figure which I have given of *A. Eichhornii* found at Bombay, bodies are drawn which I conjectured to be respectively the nucleus and reproductive cells; but, as there is nothing so situated in the *A. Eichhornii* which I have been studying in England to identify with such bodies, the statement must be only taken for what it may prove worth hereafter. It is worthy of note, however, that Claparède says (*op. cit.* p. 452, foot-note), "En *A. Eichhornii* le nucléus est, au contraire, toujours facile à reconnaître." This certainly was not the case with any of the specimens of *A. Eichhornii*, small or great, that came under my notice; but then it might have been obscured by the vacuolation; for in another form of *Actinophrys*, which was also present, although not plentiful (viz. fig. 8), and even smaller than fig. 7, it was most evident in the endosarc, which was surrounded by a clear layer of ectosarc, bordered by a wrinkled margin or surface; but then there was no vacuolation. Probably if the vacuoles in the smaller forms of *A. Eichhornii* had been broken down, and the nucleus sought for in this way, it might have been observed; for I cannot help thinking that, at least when the spherical bodies are not present, there must be a nucleus.

Again, the absence of the nucleus, when the spherical bodies become numerous and fully developed, may be accounted for by its having passed into a brood of germ-cells, and its having thus become effete, as described and illustrated in *Diffugia* (Annals, vol. xiii. pl. 1. figs. 2, 3, 4, &c.).

When, then, we view an old *Actinophrys* with between three and four hundred of these spherules in her body, relatively analogous to, and absolutely of nearly the same size as those which I have already shown to exist in all the other Rhizopoda above

mentioned, we can hardly doubt that they are of the same kind, and that they are an impregnated brood of reproductive cells, which, in like manner, will end, on becoming matured, in the death of the parent, as in the closely allied Myxogastres (Mycetozoa of A. de Bary), ex. gr. *Æthalum*, where the prolific mother lives but to become at last a dead receptacle for the future welfare of her numerous progeny.

The family of Saprolegniæ are closely allied to that of the Myxogastres among the Fungi; and in the former Pringsheim has placed his *Pythium entophytum*, which, among other Algæ, infests the cells of *Spirogyra*, wherein I found its locomotive rhizopodous form to be so like *Actinophrys*, and, as before stated, the endoplasm of *Spirogyra* to be so like that of the latter, that I was led into the erroneous view, long since corrected, that the endoplasm of *Spirogyra* did thus actually become transformed into *Actinophrys*. This, then, will give the reader an idea of the position of *A. Eichhornii* with respect to these families.

With the general structure of *A. Eichhornii* I am not now particularly concerned. The spumaceous appearance which both the young (fig. 7) and old individuals (fig. 6) present seems to be due to vacuolation, and not to the presence of cells, according to the common acceptance of this term. Kölliker and most others who have studied this species are of the same opinion; but Prof. Clark, of Boston, has lately affirmed that these vacuoles are cells, because they have a cell-wall and alternate regularly with the tentacula (Annals, vol. xiv. p. 394). However, the presence of a wall around a sarcodal aqueous space, even with vibrating granules in it, does not, in the generally received meaning of the word, constitute a "cell." There should also be a nucleus, at one time or other at least, in most of such spaces, and they should at least also be of similar average size, form, &c., before they can be viewed as cells of an organized structure; while all this is reversed in the vacuoles of *A. Eichhornii*, which seem to me more to resemble, in accidental form and size, the fragmentary state of a veined or brecciated rock than those produced by the constant and immutable law which presides over the normal development of an organized cellular structure.

How this vacuolation is produced, and to what use it is subservient, has not been explained; but its accidental presence in the Infusoria and Algæ is not uncommon. Indeed it seems frequently to occur in the former from want of activity in the contracting vesicle—that is, after injury of the Infusorium or towards death. But in other instances, as in the first-formed cells in the germinating nucleole of *Chara*, a similar vacuolation seems

to precede and prepare the endoplasm for its rotatory function, and thus to be, as in *Actinophrys Eichhornii*, a normal condition (Annals, ser. 2. vol. xix. p. 13, "Development of Root-cell and Nucleus in *Chara*").

I do not mean to state that the "vacuoles" are "contracting vesicles," because, while they are stationary, the contracting vesicle, singly or in plurality, here and there is generally observed among them in full activity. But I am not so sure that they may not be a part of the system of which the contracting vesicle is the active organ. The occasional coalescence of the vacuoles, and their occurrence in the cortical part or ectosarc alone (figs. 4, 5) or when throughout the *Actinophrys* (as in figs. 6, 7), those of the ectosarc being differentiated by size, &c., from those of the endosarc, lead me to the inference that the spumaceous state of *A. Eichhornii* is due to a simple aqueous vacuolation, which forms part of the system of which the contracting vesicle, as just stated, is the chief agent, and therefore that its function probably is partly, if not chiefly, that of aëration, wherever it may occur as a normal adjunct. It is worthy of remark, while on this subject, that the young *Pythium entophytum*, on issuing from the parent capsule as a simple monociliated spherical body, apparently without contracting vesicle, sinks down almost immediately, and at the same moment presents the contracting vesicle, which, for a time, by the rapidity of its action and the size to which the inflation extends, seems to threaten destruction to the delicate little Rhizopod, until its function (which certainly looks like one of aëration) has had its full effect, when the contracting vesicle returns to its normal condition, the cilium disappears, and the little *Pythium* assumes the form, and progresses after the manner, of *Actinophrys*.

As regards the presence and absence of the contracting vesicle in the Rhizopoda, but more especially in the family which is now under consideration, I think it of no specific value whatever. It may be present singly or in more or less plurality, or absent altogether, according to circumstances; but in many Rhizopods, when present in its normal state, it seems to have a fixed position in the animalcule, as in *Euglypha*, *Arcella*, &c.

Again, the presence or absence of the nucleus in *Actinophrys* appears to be contingent. It is probably present in all the the younger forms; but as they advance towards the production of the new brood, it may disappear in the formation of germ-cells alone, or it may partly furnish germ-, and partly sperm-cells, in which case the spherical bodies in the endosarc of *A. Eichhornii* may also, perhaps, originate from the nucleus, as conjectured by Dr. Wallich (*l. c.*); but if the nucleus furnishes the germ-cells alone, then the others may be developed in the

substance of the ectosarc, as their occurrence there, apparently in all stages of development, seems to imply.

Lastly, then, it may be asked, What are the specific distinctions among the Actinophryans? To which it must still be replied, Future observation must determine.

ACINETINA, Clap. & Lach.

I have observed several species of Acinetina in both the fresh and salt water of the island of Bombay, viz. *Podophrya fixa*, Ehr., *P. quadripartita*, Clap. & Lachm. (on *Epistylis*), *Sphærophrya*, C. & L., *Acineta tuberosa*, Ehr., and two or three others unpublished, of which I hope to give descriptions and delineations at some future time, my object being now more particularly to direct attention to the two commonest, and therefore those with which I am most conversant, not because they are new (for this they are not), or because they present differences which I think hitherto have not been noticed, but because they serve best to illustrate phenomena which have not been so pointedly exposed as they seem to me to deserve. These Acinetina are, no doubt, both forms of one species, viz. of *Podophrya fixa*; but while one (fig. 9) inhabits the fresh water of the pools, the other (fig. 10) is found in the salt water of the main drain of the island; and the differences between them are, that the former is a little larger and has a conical capsule, with few costæ (fig. 9 *e*), while the latter has a globular capsule, with many costæ (fig. 10 *d*). That such differences are constant, my sketches of each, made on several separate occasions, go to establish.

Having thus introduced these forms to the reader, I will now proceed to describe and illustrate the phenomena to which I have just now and often before alluded, but which, as above stated, I do not think have been so prominently brought to notice as they deserve, viz. the remarkable and almost unique example of an Infusorium being able to put forth and retract both vibratile cilia and capitate tentacula as they may be required, while this is apparently effected as much by extemporization as the stomachal spaces and digital prolongations of *Amœba*. These phenomena are witnessed not only when the *Podophrya* (figs. 9 & 10) undergoes duplicative division, but also during the changes which the young *Podophrya* undergoes from the time of its exit from the parent to its matured or tentaculated condition (fig. 11).

In the first instance, the *Podophrya* is seen to pass from its spherical to an elongated form, after which it presents a constriction in the middle, and the young half, becoming oblong, retracts its tentacula and throws out a wreath of cilia (fig. 9 *a, b*).

Separation then takes place, and the tentacula again begin to appear (*b*, *c*), when, in their turn, the cilia are retracted, the tentacula fully reproduced, and, finally, the young half (*d*) assumes the spherical form of the older one or parent (*a*).

In the second instance, the young *Acineta* (for my sketches of this happen to be taken from the young of *A. tuberosa*) leaves the parent with a wreath of cilia round its smaller extremity (fig. 11 *a*), in such a state of activity that it is difficult to follow it to its resting-place. This, however, soon takes place, and if successfully kept in view, the cilia will be found, on its having become stationary, to present a curved form, which has been occasioned by the centripetal force communicated to them by the young *Acineta* which they have been rotating in the opposite direction (*b*). The cilia then regain their straightness, and assume a radiated form, on which they begin to be retracted (*c*). After this, the tentacula appear (*d*); and finally the latter are fully extended, and the cilia withdrawn (*e*). This would be the end of the series in *Podophrya*; but *Acineta tuberosa* being a stalked form, its final development is not completed until this has been attained.

By some it might be said, as before stated, that the cilia and tentacula are as much extemporized as the stomachal spaces and digital prolongations of *Amæba*, while others would adhere to the opposite view. It is almost as difficult to conceive one as the other—that is, how vibratile cilia and tentacula, organs of totally different forms, and endowed with totally different functions and movements, can exist and be made to appear and disappear, with less complicated machinery than that which must necessarily accompany similar organs in animals much higher in the scale of development.

Perhaps there are no phenomena more remarkable among the Rhizopoda, in themselves or for the facts which they establish, than those just described, and none more easily followed and witnessed when the forms of *Acinetina* mentioned have been obtained for observation; for while some are continually undergoing duplicative division, the others are as continually sending forth a young one.

They are extremely restless animalcules in all respects, sometimes hardly being encapsuled before they burst forth again, and then become encapsuled a second time before the whole of their substance has left the first capsule (fig. 10 *e*). Both these forms of *Podophrya* also may be stalked (10 *c*).

For other observations on the *Acinetina*, containing views respecting their parasitic nature, &c., see my "Notes and Corrections" (Annals, vol. viii. p. 281, 1861).

COLLODICTYON, nov. gen.

Collodictyon triciliatum, n. sp. Pl. XII. fig. 12.

Pyriform, straight, or slightly bent upon itself, bifid at the small extremity, presenting at the larger one an indentation, from which spring three cilia. Structure transparent, cancellated, composed of globular cells, with a strongly marked greenish granule here and there in the triangular spaces between them. Locomotive, swimming by means of the cilia; subpolymorphic, flexible, yielding, capable of assuming a globular form (*f*) or one more or less modified by the body it may incept (*c*, *d*, *g*); enclosing crude material for nourishment in stomachal spaces, and ejecting the refuse, like *Amæba*. Provided with a nucleus and contracting vesicles.

Hab. Fresh water, chiefly among *Euglenæ* and Infusoria of that kind.

Size. Length $\frac{1}{771}$ st of an inch.

Loc. Island of Bombay.

Obs. The plastic nature of this infusorium, and its mode of incepting food being like that of *Amæba* (for it does not appear to possess any oral aperture), induce me to think that it should be placed among the Rhizopoda. Still it seems to have some analogies with *Bodo*, Ehr. The curved form (*e*) approaches that of the colourless *Bodo* found in bunches, but, of course, is very much larger. If *Collodictyon* be a *Bodo*, then it is a large form of the latter, as *Anisonema* is a large form of the diplociliated Monad. Again, what *Astasia limpida*, Duj. (*Trachelius trichophorus*, Ehr.), is to *Euglena*, *Collodictyon* is to the cordiform, triciliated, *Euglena*-like Infusoria, of which probably *Polyselmis viridis*, Duj. (Hist. des Zooph. Infus. pl. 3. fig. 27) is one; that is, *Collodictyon* is the animal and *Polyselmis* the vegetable form of this Infusorium. Its generic name has been derived from its plasticity and delicate cellular structure, which gives it a reticular or cancellated appearance; and its specific designation from the presence of the three cilia. In voracity it is so greedy that it will frequently enclose part of a body which it is not large enough to enclose entirely (*g*); that is also like *Bodo*. The cellular spaces which pervade its body are uniform and globular, not variable in size and polygonal like those of *Actinophrys Eichhornii*; otherwise it so far resembles this Rhizopod. I have not inserted the contracting vesicles in the figures, because they are not to be found in my sketches, probably from their having no fixed position. The bifid extremity, although like the commencement of duplicative division, is, I think, a persistent character. Although this infusorium is very common in the island

of Bombay, it is so restless, and its movements so rapid, that it is difficult to get at its real form.

EUGLYPHA, Duj.

Euglypha spinosa, n. sp. Pl. XII. fig. 13.

Test. Oblong, rather wider in front than behind on the broad side, compressed, wedge-shaped, convex anteriorly and posteriorly, translucent, covered with subcircular plates, which, overlapping each other, present a more or less irregularly cancellated appearance (*b*). Aperture rimous, extending throughout the anterior border. Ventral portion more or less inflated. Sides and posterior extremity narrow, terminating in an angular ridge, which behind, and for two-thirds of its length laterally, supports a row of moveable spines based on fixed tubercles, like those of *Cidaris* (*c c c c*). Spines clavate, pointed at their free ends (*c'*).

Animal. Sarcodae containing fragments of incepted food and granules anteriorly (*f*), behind which it is charged with granules alone (*g*); and posterior to all is the nucleus (*h*). Pseudopodia and contracting vesicles not seen, but probably the same as in *Euglypha alveolata*, &c.

Hab. Heath-bog water.

Size. Length $\frac{1}{11}$ st, breadth $\frac{1}{285}$ th of an inch.

Loc. Budleigh-Salterton, South Devon.

Obs. I have only seen two or three specimens of this Rhizopod; and, it being winter, the animal part in all was passive. Thus the aperture was in all probability much more compressed than during active life. The sarcodae was retracted, and there was a kind of diaphragm about halfway between it and the anterior extremity. The most remarkable feature about it, next to its wedge-like shape, is the presence of spines, which, in some instances, lying across each other while the tubercles remained fixed, showed that they were moveable, like those of the Echinodermata. Widely separated, however, as the latter are from the Rhizopoda, still they have many points of resemblance in their living state, and are frequently and almost exclusively associated in a fossil one.

Euglypha globosa, n. sp. Pl. XII. fig. 14.

Test. Globular, with a short compressed wedge-shaped neck and narrow aperture, which can be closed by the animal (*a*). Globular portion translucent, covered with uniformly circular scales, which are so arranged as to slightly overlap each other hexagonally, and thus present a cancellated structure of the most regular appearance. Neck studded with minute points, perhaps minute scales. Supernumerary scales within the test (*e e*).

Animal. The same as that just described, and as in *Euglypha* generally. Pseudopodia and contracting vesicles not seen, but may also be inferred to be the same as in *Euglypha*.

Hab. Heath-bog water.

Size. Body $\frac{1}{545}$ th of an inch in diameter; neck $\frac{1}{1200}$ th broad.

Loc. Budleigh-Salterton, South Devon.

Obs. This species is very plentiful in its habitat, but very small. Its features are very constant, and its size also; but I have never been able to see its pseudopodia, although I have watched it long and repeatedly. The presence of supernumerary scales in it is exactly like that which I have already figured in *Euglypha alveolata* and in *E. pleurostoma* (Dujardin's *Trinema*). Its relative size, as well as that of *E. spinosa*, in proportion to the other testaceous Rhizopoda which I have figured (*l. c.*), will be observed in dotted outlines (figs. 13 *g* and 14 *d*).

EXPLANATION OF PLATE XII.

N.B.—Figures 1 to 10, inclusive, are drawn upon the scale of $\frac{1}{24}$ th to $\frac{1}{5400}$ th of an inch, and fig. 11 upon a little larger scale. Figure 12 is upon the scale of $\frac{1}{12}$ th to $\frac{1}{5400}$ th of an inch, and fig. 13 upon that of $\frac{1}{24}$ th to $\frac{1}{5000}$ th of an inch, while fig. 14 is upon the scale of $\frac{1}{6}$ th to $\frac{1}{5000}$ th of an inch. Figures 13 *d* and 14 *g* are outlines of figs. 13 and 14 respectively, on the scale of $\frac{1}{6}$ th to $\frac{1}{5400}$ th of an inch, for comparison with those of the testaceous Rhizopoda in plate 1, vol. xiii. of the 'Annals,' which are on the same scale; and fig. 12 *h, i* would be the lengths respectively of fig. 12, if drawn on the scales first and last mentioned in this paragraph.

The Actinophryina and Acinetina should be viewed not as discoidal, but globular bodies, with tentacles proceeding from their surfaces generally, and therefore the marginal lines of vacuoles only as an indication of the peripheral or ectosarcal layer which exists all over them respectively.

Fig. 1. *Actinophrys oculata*, Stein. Group of four individuals, the largest $\frac{1}{550}$ th of an inch in diameter, each presenting a nucleus and nucleolus, and all bearing drops of sarcode on their tentacles, but the latter only represented in *a*; *b*, uniting sarcode; *c*, vacuoles in the latter, containing food; *d*, vacuoles containing each a subrotund, colourless, amylaceous (?) body.

Fig. 2. The same: outline only of a group of nine individuals, in every respect the same as those of fig. 8, but with smooth tentacles: *a*, circles representing the Actinophryans, $\frac{1}{540}$ th of an inch in diameter; *b*, uniting sarcode; *c c*, vacuoles in the latter, containing respectively the remains of a rotatory animalcule; *d*, as before.

Fig. 3. The same (?), in the form of *Actinophrys Sol* (?); nine individuals in the group, closely approximated, and varying in size, the largest (*a*) being $\frac{1}{415}$ th of an inch in diameter; *b*, two or three in zygotis; uniting sarcode not seen; *c*, vacuoles in the latter, containing food; *d*, as before. All the above from salt water, in India.

Fig. 4. *Actinophrys Sol* (?); three separate individuals, each $\frac{1}{415}$ th of an inch in diameter, each bearing tentacles, each presenting an ectosarcal layer of vacuoles, but no nucleus: *a*, specimen with

vacuoles uniformly small; *b*, ditto with large; *c*, ditto with both small and large, and the tentacles on this bearing drops of sarcode. India, fresh water (?).

Fig. 5. The same (?) "As the foregoing, but with the tentacles bearing little spherical bulbs of sarcode at their ends as well as drops along their course, the interior containing Diatoms. India, fresh water.

Fig. 6. *A. Eichhornii*, Ehr. Fragment of an individual, $\frac{1}{30}$ th of an inch in diameter, magnified upon the same scale as the foregoing: *a a a a*, peripheral or ectosarc layer of vacuoles, the larger ones $\frac{1}{30}$ th of an inch in diameter; *b b b b*, dotted lines indicating respectively the circumference of the figure and the width of the ectosarc layer; *c c c c*, vacuolation of the endosarc, in which the interstices are much smaller than those of the ectosarc; *d d d d*, spherical bodies or reproductive cells, about $\frac{1}{200}$ th of an inch in diameter, as they appear in the intervals between the vacuoles of the endosarc; *e*, more magnified view, showing that these bodies are, in their advanced stage, respectively enclosed within a transparent spherical cell or capsule, and that the former presents a group of granules in the centre of its plasmic contents; (here we seem to have the first elements of an *Actinophrys*, viz. an ectosarc, endosarc, and "granules," which, in one specimen that I observed, still nearer approached it by the transparent cell presenting a fine protoplasm without granules, and a vacuole); *f*, the same before the formation of the cell; *g*, three of the same, of different sizes, before the granules appear; *h*, two of the same (on the scale of those seen in the "fragment") enclosed in one cell; *i i*, tentacles covered with ectosarc; *k k*, axial portion extended from the endosarc; *l*, vibratile granules of the cells. England, fresh water.

Fig. 7. The same; specimen of individuals $\frac{1}{400}$ th of an inch in diameter accompanying the larger ones just mentioned, but in which neither nucleus nor reproductive bodies were observed. England, fresh water.

Fig. 8. *Actinophrys* —? specimen $\frac{1}{44}$ th of an inch in diameter; ectosarc surrounded by a wrinkled surface, as in *A. oculata*, and differentiated from the granular and more clouded endosarc by a more translucent and finer material; endosarc presenting a well-defined nucleus. Found with the foregoing, in fresh water.

Fig. 9. *Podophrya fixa*, Ehr.: *a*, parent half, $\frac{1}{60}$ th of an inch in diameter, undergoing duplicative division, tentaculated, but without cilia; *b*, daughter half, elongated and becoming separate, presenting vibratile cilia and a few short tentacles; *c, d*, another instance, in which the separated and elongated portion, *c*, with vibratile cilia and a few short tentacles, has passed into the spherical form, *d*, without vibratile cilia and with long tentacles; *e*, conical capsule of this variety, presenting fourteen costæ. India, fresh water.

Fig. 10. The same (?): *a*, parent half, $\frac{1}{77}$ st of an inch in diameter; *b*, daughter half nearly separated, presenting vibratile cilia, &c.; *c*, stalked condition; *d*, spherical capsule of this variety, presenting eighteen costæ; *e*, instance where the *Podophrya* has nearly left its first capsule, and has formed another around itself on the top of the original one. India, salt water. In almost all those here figured, the contracting vesicle and the nucleus, which appeared to be globular, were observed.

- Fig. 11. *Acineta tuberosa*, Ehr., embryo of, showing, in series, the changes which it undergoes from the active state on its exit from the parent, to its passive, tentaculated, and spherical form: *a*, active state on issuing from the parent, when it is provided with a circlet of vibratile cilia; *b*, its globular form, assumed on becoming comparatively passive and stationary, $\frac{1}{135}$ th of an inch in diameter, the cilia passive and curved from the centripetal force occasioned by the rotatory motion which they originally communicated to the young *Acineta* in its active state; *c*, the cilia regaining their straightness, and becoming shorter; *d*, the cilia disappearing, and short tentacles projected; *e*, the cilia gone and the tentacles increased in number and elongated. India, fresh water.
- Fig. 12. *Collodictyon triciliatum*, n. sp. Length $\frac{1}{77}$ th of an inch: *a*, posterior (?) view, showing bifid extremity, three cilia, central line and nucleus, cellular structure and granules; *b*, lateral view; *c*, presenting a digestive space containing an incepted *Proto-coccus* in the 8-cell division; *d*, ditto containing a *Crumenula texta* nearly as large as itself; *e*, outline of another but common form of this Rhizopod; *f*, ditto of a globular form; *g*, one enclosing the central portion of a filament of *Oscillatoria*, while the two ends are outside the animalcule; *h*, length on the same scale as the Actinophryans; *i*, length on the same scale as that of the testaceous Rhizopoda, figs. 13 *d* and 14 *g*. India, fresh water.
- Fig. 13. *Euglypha spinosa*, n. sp.; specimen $\frac{1}{77}$ th of an inch long and $\frac{1}{85}$ th of an inch broad; animal retracted within a diaphragm, and passive: *a*, view of broad side of test; *a'*, ditto of narrow side, or lateral view; *b*, scales on test; *c c c*, moveable spines on fixed tubercles; *c'*, more magnified view of the spine; *d*, dotted outline of test on a scale of $\frac{1}{6}$ th to $\frac{1}{830}$ th of an inch, for comparison with other figures of testaceous Rhizopoda, *l. c.*; *e*, diaphragm; *f*, portion of sarcode containing fragments of food; *g*, ditto charged with granules; *h*, nucleus. England, fresh water.
- Fig. 14. *Euglypha globosa*, n. sp.; specimens $\frac{1}{45}$ th of an inch in diameter: *a*, empty test covered with circular scales hexagonally arranged, also showing the broad side of the neck and open aperture; *b*, ditto, showing the narrow side (or lateral view) of the neck and closed aperture, also *c c*, supernumerary scales; *d*, test containing the animal, passive, with closed aperture; *e*, sarcode containing fragments of food; *f*, nucleus in posterior and granular portion of sarcode. England, fresh water.

XXXIII.—*Contribution towards the Knowledge of the Rhynchoprion penetrans.* By HERMANN KARSTEN*.

[Plates VIII. & IX.]

[In this paper Professor Karsten remarks upon the imperfect knowledge which we still possess of this curious parasite—the Nigua, Chigoe, Jigger, or Sand-Flea of tropical America,—notwithstanding that the first European visitors to the New World

* Translated from a separate copy of the paper in the 'Bulletin' of the Society of Naturalists of Moscow, communicated by the author.

seem to have experienced its attacks. Its generic synonymy is given by Professor Karsten as follows:—

Pulex, Linn. 1767.

Rhynchoprion, Oken (not Hermann), 1815.

Sarcophaga, Guilding, MS., Westwood.

Dermatophilus, Guérin, 1836.¹

Sarcopsylla, Westwood, 1837.

Professor Karsten commences his memoir with a series of extracts from the various writers who have mentioned the Nigua, the references to which will be found in the accompanying list †. The results of his own investigations are then communicated in the following words.]

- **Oviedo*, Cronica de las Indias, 1547, fol. xxi.
- Hans Staden*, Wahrhaftige History, &c., 1557, cap. 33.
- Abbeville*, quoted by *Sloane*, p. 256.
- Jean de Lery*, Voyage du Brésil, 1585, p. 168.
- R. Hakluyt*, The Principal Navigations, &c., London, 1598–1600, p. 449.
- J. de Laet*, Beschrywinghe van West Indien, 1630, p. 6.
- Marcgrav Piso*, Historia rerum naturalium Brasiliæ, 1648, p. 249.
- R. Ligon*, History of Barbadoes, 1657, p. 109.
- Du Tertre*, Histoire des Antilles, 1667, vol. ii. p. 353, § 12.
- Rocheport*, Histoire Naturelle des Antilles, 1668, cap. xxiv. art. vi. p. 272.
- Hans Sloane*, Voyage and Natural History of Jamaica, 1707–1725, i. p. cxxiv and ii. p. 191.
- Frezier*, Reise nach der Südsee, &c., 1718, p. 310.
- Gumilla*, Historia del Orenoko, 1745.
- **Ulloa*, Relacion Historica del viaje a la America meridional, 1748, libro i. cap. viii. p. 88.
- Catesby*, Natural History of Carolina, &c., 1743, vol. ii. Appendix, p. 10. fig. 3.
- Barrère*, Nouvelle Relation de la France équinoxiale, 1743, p. 63.
- Patrick Brown*, Natural History of Jamaica, 1756, ii. p. 418.
- Linné*, Systema Naturæ, ed. 12, 1767, p. 1021.
- Bancroft*, Natural History of Guiana, 1769, p. 245.
- Hartsinck*, Guyana, 1770, i. p. 105.
- Chappe d'Auteroche*, Voyage en Californie, 1772, p. 20.
- Molina*, Saggio sulla storia naturale de Chili, 1782, p. 214.
- **Dobrizhoffer*, Historia de Abiponibus, 1784.

The first educated naturalist who described the Nigua from personal examination was

- **O. Swartz*, Kongl. Vetensk. Acad. Nya Handl., Stockholm, 1788, tom. ix. p. 46 (*Pulex penetrans*).
- **Rodschied*, Medicinische und Chirurgische Bemerkungen über das Clima, &c., von Essequibo, 1796, p. 307.
- Azara*, Voyages dans l'Amérique méridionale, 1809.
- Southey*, History of Brazil, 1810, i. p. 326.
- Von Sack*, Reise nach Surinam, 1821, p. 239.
- Oken*, Naturgeschichte, 1815, Bd. iii. Th. i. p. 402 ("Rhynchoprion" referred to the Acari).

† The more important references are marked with an asterisk.

- Humboldt*, Voyage du Nouveau Continent, 1820-1822, tom. vii. cap. 19. p. 250, and cap. 20. p. 129.
Duméril, Considérations générales, 1823, pl. 54. figs. 4, 5.
Latreille, Règne Animal, 1829, iv. p. 351.
Kirby and Spence, Introduction, 1828, vol. i. p. 102.
 **Pohl*, Reise in Brasilien, 1832, i. p. 106.
Aug. St.-Hilaire, Voyage dans Rio Janeiro, 1830, i. p. 35, and Voyage du Brésil, 1833, i. p. 228.
 **Rengger*, Reise nach Paraguay, 1835, p. 274.
Waterton, Loudon's Magazine of Natural History, 1836.
 **Dugès*, Annales des Sciences Naturelles, 2 sér. tome vi. 1836, p. 129.
 **Guérin-Méneville*, Iconographie du Règne Animal, Insectes, p. 12 (*Dermatophilus*).
 **W. Sells*, Transactions of the Entomological Society, vol. ii. p. 195.
 **J. O. Westwood*, Ibid. p. 199 (*Sarcopsylla penetrans*).
 **Tschudi*, Peru-Reiseskizzen, 1846, i. p. 310.
R. Schomburgk, History of Barbadoes, 1847, p. 652.
 **Burmeister*, Reise nach Brasilien, 1853, p. 284.

All these descriptions originate in tropical and subtropical America, in the region which has always been regarded as the sole country of *Rhynchoprion penetrans*; the insect does not occur in other parts of the world.

Adanson, indeed, in his 'Voyage to the Senegal' (1757), mentions a kind of very small Flea, which resides in extraordinary quantities in the sand of the huts, for which reason it has received the name of the Sand-flea; but, from his further statements, it appears that he does not refer to the *Pulex penetrans*, Linn.; for he says, "Fortunately its puncture is not very painful, and it consequently produces so intolerable an itching only because it attacks the body in such great numbers. The most remarkable circumstance," adds Adanson, "is that the insect usually does not creep or leap to a greater height than three inches." The latter peculiarity, like the name, reminds us of *R. penetrans*; but, if it had been this species, Adanson would certainly have given us a fuller account of it.

The most southern habitat of *Rhynchoprion* is that given by Dobrizhoffer and Azara, namely, Paraguay, under the 29th degree of south latitude. According to Auteroche, it is very abundant in Vera Cruz, in 20° N. lat.; and from the same authority, as also from John Smith (cited by Sloane), the insect appears to occur up to the latitude of Virginia, about 30° N.

Everywhere the insect, which affects warm and dry places, is met with in the vicinity of human habitations, either occupied or deserted. All the accounts of the occurrence of this animal in fields, woods, and plantations are due to confusion with species of *Ixodes*, except when these statements refer to the leaf-huts made by field-labourers or travellers to give them shelter for a night or for a short time. Such huts or leafy roofs, when deserted by human inhabitants, usually become the dwelling-

place of rats, mice, and similar animals, which seek shelter there from the rains, so long as the roof offers it to them; and these animals then serve for the preservation and increase of any progeny of the Nigua that may have been left behind by the travellers; hence it is that such places often particularly abound in Niguas, which attack new-comers in great numbers, as I know from personal experience. The same thing occurs, as indeed Rengger relates, in the deserted houses of planters, in the rooms of which the Niguas developed from the eggs left behind at first collect in extraordinary numbers, but afterwards diminish again, and finally disappear entirely, no doubt because these places are not so convenient for the access and long residence even of the smaller mammalia, so that the Fleas cannot increase, and consequently at last die out.

Rengger's statement that animals living in a wild state are not attacked by the Nigua is consequently not correct, and has already been refuted by several travellers. In Schmarda's rich collection I found a Field-mouse from Cuenca, the tail and foot of which harboured a great quantity of Niguas* (Pl. VIII. fig. 1).

Swartz, Rengger, Humboldt, and other travellers report that strangers are particularly attacked by the Sand-flea on their arrival in America. It is true that new comers, to whom the inconspicuous insect is unknown, have usually to suffer more from it than others. During my residence in Venezuela I was myself much plagued by it at first, whilst in the latter years of my tropical travels in New Granada I was scarcely ever attacked by a Nigua, although the Creoles at the same places complained much of them. This, however, is favourable neither to Humboldt's hypothesis of the delicate discrimination of the Nigua between European and Creole blood, nor to Rengger's notion that the human body loses some property which attracts the Nigua.

The fact that in newly arrived foreigners the Niguas collect in greater numbers, acquire a larger growth within the skin, and consequently cause more violent symptoms, admits of this simple explanation:—The strangers do not notice the slight tickling produced by the penetration of the animal into the skin, as they do not understand the meaning of this slight pain; and the animal, after it has taken its place, causes no further inconvenience, if the slightly inflamed spot of skin which it inhabits

* Of these Niguas I removed two from the skin, in order to examine their specific characters. I could find no perceptible difference from the other individuals examined; but I noticed the very remarkable fact, inexplicable by me, that in both of them all the legs were wanting up to the trochanters,

is not pressed or scratched. The particular state of the skin as regards irritability will also have its influence, as also the greater or less activity of the skin. It is true that the inhabitants of Caracas have also remarked that, of newly arrived colonists, the French, like the negroes, suffer particularly from the parasitic flea.

The Nigua is a parasite only during one period of its life; for the impregnated female alone bores into the skin of warm-blooded animals: the unfecundated females and the males do not live parasitically. The dark brown colour of the contents of the stomach in the animals which are found running about indicates that, like the allied Fleas, they live on blood.

The true colour of the body of the free-living Niguas (leaving out of consideration the dark colour of the contents of the stomach) is yellowish; I have never seen a brown or black *R. penetrans*, such as are mentioned by Ulloa, Auteroche, and many others. The dilated bodies of the Niguas which had established themselves under my own toe-nails, and more rarely on other parts of the skin, as also of those which I observed on other people and on animals, were of a more or less pure white colour; those derived from the skins of negroes appeared grey—probably only influenced by the pigment existing there. No differences of form could be detected.

From its light colour, the size of the Nigua has been greatly underrated by most describers; for it measures, on the average, 1 millim. (half, or more than half, the size of the common Flea). The males and females are at first of the same size, and it is only during the endoparasitic life of the fecundated female that its body enlarges to the extraordinary diameter of 5 millim.

As long as the pregnant female remains in the skin undisturbed by pressure or rubbing, it produces, as far as my experience goes, no further perceptible inconvenience; it grows to the size above mentioned, and in this condition remains long without alteration. The inconsiderable inflammation, exciting a slight tickling sensation, which is produced in the skin by the assimilating animal, is greatly increased by any irritation of the part affected, and might probably, in bad constitutions, give rise to those destructive effects which have been cited by various writers, and which I have also heard spoken of. I have frequently seen young negroes with purulent feet destitute of toes, limping about upon their heels, who indicated the Niguas as the cause of their sufferings. Consequently it is possible that there may be some truth in the narrative of Walton, cited by Kirby and Spence, of the capuchin who had to pay with his foot for his desire to make this animal known in Europe.

There is no doubt that negroes are often attacked by tetanus

when they wet their feet with water after the extraction of a Nigua; but this is no peculiar effect of the Nigua.

The swelling of the inguinal glands, observed by Ulloa and Jussieu, which led them to conclude that a second species existed, occurred once in my own person in La Guayra. Whether this phenomenon is the specific effect of a peculiar species of animal, or to be referred to the same category with the similar consequences of other slight injuries to the lymphatics of the foot, which is my own opinion, must be left to the future to decide. Spix and Martius also mention swellings of the inguinal glands in consequence of the penetration of Niguas.

I cannot from my own observations confirm the opinion that there are two different species of Niguas, a malignant and an innocuous kind, of which the latter, according to Ulloa, is of a dark colour.

The inflation of the abdomen in the Flea, when imbedded in the skin, takes place very rapidly, as has been remarked by all observers. Ulloa's statement that the animal enlarges to a diameter of two lines in four or five days, according to the individual nature of the insect and of the subject attacked by it, may be regarded as nearly correct.

The animal imbedded in the skin, usually under the toe-nails, when it has become quiescent in its new dwelling-place (that is to say, when it has got so far under the epidermis that its anus, lying at the same level, closes the orifice formed in the epidermis) produces scarcely any inflammation or sensation of pain, unless, as already stated, the affected spot is injured or irritated by pressure or friction, in which case both these symptoms make their appearance, just as in a frozen limb. The increased heat and softness of the skin, in consequence of the inflammation, attract other Niguas, and facilitate their penetration in the vicinity of the first one. This is the cause of the juxtaposition of several Niguas, described by various authors, and which, indeed, is not unusual—and not, as stated by all writers since the time of Oviedo, the exclusion of the larvæ from the eggs in the wound or in the uninjured body of the mother. Even Pohl and Kollar, probably misled and rendered doubtful of the correctness of their own observations by the statements of their predecessors, adopt this notion of Oviedo's, although they rightly understood the conditions of development and the deposition of the eggs.

As is so frequently the case, the simplest and most natural state of things is the last to be recognized as the true one, after all sorts of by-paths have been tried (I need only refer to the theories of the origin and metamorphosis of the organic cell); and the same thing has occurred here.

For we may easily be convinced that eggs alone, and never larvæ, are contained in the female flea, and that the most perfect of these lie nearest to the cloaca; and any one who has frequently had to remove the dilated female from the skin will have remarked the projection of a perfectly mature egg from the body of the mother on the slightest pressure being applied to the latter with the needle, &c. The very numerous ovicells which occur in the cylindrical tubes of the simply furcate ovary are gradually developed in such a manner that the most mature egg is always situated next to the issue, and is driven forth by the pressure of the other growing ova before the process of segmentation or any other commencement of embryonal development has taken place. In this way the parent animal remains within the skin without any further enlargement until all the eggs are developed and deposited, after which, no doubt, the evacuated and shrivelled body is finally thrown off with the epidermis during the advancing development of the skin—an opinion which might perhaps be fortified by the statements of Rengger (p. 110) and Burmeister (p. 126).

Rengger's statement that the mature egg-sac separates from the organism which has furnished it with nutriment, and that then, in a few days, a number of larvæ creep out of it, is refuted at once by the mode of lodgment and the constant enclosure of the body of the Flea in the skin.

The extraction of the parasite from the skin is, as stated by Gumilla, far more easily effected at a later period than in the first hours and during the penetration, because then the animal, which is working briskly, only increases its efforts by the aid of its mandibles, which are peculiarly adapted for the purpose, and, indeed, fastens these so firmly in the skin that they are not unfrequently torn away from the body of the Flea, and remain sticking in the skin, when the animal is removed with violence. As early as the next day the voluntary activity of the animal is much diminished, and then, but with still more certainty after the lapse of a few days, with a little care the epidermis may readily be pushed aside with a blunt knife or a needle, all round the Flea without injuring the latter, and thus the globular animal may be so far exposed that these instruments or a fine pair of forceps may be got under its body, and it may then be removed without much resistance and by slight pressure, with all the buccal organs, which project far into the true skin (the rootlets or filaments of Sloane, Ulloa, and Schwartz). But if, in removing the dilated and delicate body which adheres more or less closely to the surrounding cellular tissue of the skin, we proceed so clumsily as to tear it, so that a portion of it, with the piercing-apparatus imbedded in the corium, is left behind in the

skin, lymph flows continually from the wound, and a purulent condition soon setting in converts the originally small wound into a more or less extensive sore.

The opinion expressed even by the first writers on this parasitic animal, and repeated by various later authors, that there are two species of its genus, is founded by them partly on the difference of coloration already referred to, and partly on the length of the buccal organs. In all the animals examined by me, however, the latter were at the utmost about one sixth longer than in the common Flea, attaining scarcely half the length of the body of the free animal; whilst Linnæus and his successors characterize this species by the piercing-apparatus being equal in length to the whole body. From my own observations, I should have been the more inclined to regard this statement as erroneous, because I do not find it noticed by any of the predecessors of Linnæus with whose works I am acquainted (I have been unable to find Rolander's statement with regard to this insect, cited by Linnæus), if Westwood did not expressly confirm the Linnæan diagnosis. Westwood examined the specimens brought by Sells from Jamaica. Swartz also observed the animal in that island, but he figures the mandibles as only of the length observed by me. Is it possible that the limits of distribution of two species of this genus of Fleas may coincide in the Antilles,—namely, a long-beaked North American species and a South American one with shorter buccal organs*? Westwood's figures of this animal, imperfect as they are, are favourable neither to this hypothesis nor to the accuracy of his investigations, as they also represent the mandibles of the usual length.

We are therefore at present with certainty acquainted only with one species of *Nigua*; the existence of a second species has still to be demonstrated, although Westwood has already given it a name by anticipation, calling it *Sarcopsylla Canis* from the supposition that it especially inhabits dogs, notwithstanding that the *Nigua* taken from a dog, and fully described by Pohl and Kollar, is regarded as belonging to the Linnæan species.

For the earliest account of the different organs of which the piercing-apparatus of *R. penetrans* is composed, as also of their form, we are indebted to Dugès, who detected the maxillæ with their palpi, the median piercing-organ, the structure of the mandibles, and the presence of the labium. More recent observers have not completed these statements; on the contrary, the

* Besides the above-mentioned specimens of *Rhynchoprion*, brought by Schmarda from Cuença, and those which I observed in Venezuela and New Granada, I have examined others brought by Dr. Carl Martin from San Paulo, in Brazil, and entrusted to me for this purpose.

maxillæ have not again been detected, although they are present, and nearly of the form figured by Dugès. These maxillæ (Pl. IX. figs. 3, 4, & 13) are so broad that they cover the base of the mandibles with their anterior margins, which do not project beyond the cheeks, but are fringed with several rows of fine setæ directed downwards. They are flat, almost triangular, lie close together, and bear on their outer surface, near the upper margin, the four-jointed palpi (Pl. VIII. figs. 3 & 8, and Pl. IX. figs. 1 & 13), which are roughly setose above, and of which the lowest, longest joint is bent inwards at its base, and furnished on the outer surface of the curvature with a circular orifice, or, rather, membranaceous spot.

The length of the first three joints of these palpi varies remarkably in different individuals: sometimes these are all of equal length; sometimes the third is the largest; sometimes the second exceeds the other two. The comparative length of these joints furnishes no certain and constant character.

The mandibles (Pl. IX. figs. 12 & 13) are about one-fourth longer than these maxillary palpi, and remarkably similar both in form and size to those of *Pulex irritans*, Linn.: their form is that of linear, shallow channels; on the margin and external surfaces along the margin they are nodosely notched and striated; in the median line of the organ these striæ are separated from each other by a smooth surface. At the base, which is covered by the maxillæ, the striation is lost at the upper margin, and is only indicated by some acute denticles standing singly on the margin. At the apex itself (Pl. IX. fig. 12), where the nodose striæ of the lateral surfaces are much diminished, and only indicated by a few knots, there is, in each mandible, at the extremity of the smooth median surface, a small hook, curved outwards and attached by an enlarged base, which is no doubt partly the cause of the difficulty of extracting the animal when still capable of quick motion and engaged in boring into the skin.

In the cavity of parabolic section which these two channeled bodies enclose between them is situated the median piercing-organ (Pl. IX. figs. 13 & 14), the analogue of the epipharynx of the Diptera, the much-dilated base of which lies under the vertex, above the eyes, and forms the commencement of the œsophagus. This organ also is a channeled body, the hollow side of which is turned downwards (figs. 10 & 11). Although at the first glance this organ resembles a two-edged linear lamina, it is nevertheless prismatic in form, as its lateral walls diverge more or less rectangulary. The dorsal surface forms a sharply projecting cutting-edge, furnished at the anterior extremity with three distant teeth, of which the last one, nearest the

apex, is directed backwards, and the two others forwards. (These teeth occur in *Pulex irritans* in greater number, and along the whole length of the organ.) Internally each of the two delicate lateral walls of the channel is furnished with a thickened ridge, very finely transversely striated; by these ridges a nearly closed tube is formed at the base of the channel. At the anterior, open end of this tube, which is open longitudinally above, a strong spine is attached on each side, the apex of which projects a little beyond the body of the channel. Near these two larger spines there are also on each side four (in *P. irritans* three) somewhat weaker acicular points, which appear to be the extremities of very delicate lamellæ attached in a longitudinal position to the base of the channel. Of these, one is even a little broader than the lateral walls of the channel, so that it is seen projecting beyond these when the organ is lying on its side; this lamella (which is probably double) is somewhat chitinized, or at least of a yellowish colour, at its anterior extremity, which forms a strongly projecting tooth, whilst the others are so delicate and transparent that they are visible only with very favourable illumination, and nothing can be ascertained with certainty as to their form and mode of attachment.

In *Pulex irritans*, Linn., the organ, which is very little smaller, has nearly the same structure; but this is recognizable with difficulty in both species on account of the great delicacy and transparency of the individual parts. This piercing- and sucking-organ is not covered by an upper lip, as in the Diptera; in this, as in the allied *Pulices*, the labrum is wanting.

The labium, on the contrary (Pl. IX. figs. 3, 4, 7, 8, & 13), is just as completely developed as in the latter; it is as long as the mandibles, which it embraces from beneath, and more or less completely surrounds. The labium is divided, as in *P. irritans*, into three regions: the lowest part, which is gibbous beneath, is inserted upon the mentum (*k*, figs. 3 & 4), and is prolonged into an unjointed channel of nearly the same length, open above and anteriorly somewhat cleft. On each of the two short terminal pieces, which are truncated and greatly emarginate anteriorly, there is seated, as the third part of the labium, a linear-lanceolate, somewhat concave lamella, of the length of the two preceding regions taken together, or even somewhat longer; but this is neither jointed nor beset with bristles as in *P. irritans*. As these two palpiform appendages are attached by a narrow base to the truncated extremities of the body of the labium, they are readily broken off (Pl. IX. fig. 4*l*), for which reason they were not observed by Dugès and Guérin.

This organ is of the same form and size both in males and females; nor does the external form of the rest of the body pre-

sent any sexual variations, with the exception of differences in the form of the external generative organs. The feet (which were correctly described by Dugès) and the head and thorax are very similar in form in the two sexes.

The head is somewhat flattened on the vertex, which borders the perpendicular, almost triangular forehead, and is separated from the forehead and cheeks by a somewhat prominent ridge, having a row of small, straight, strong bristles. The occiput, which is arched and covered with very delicate hairs, comes down upon the flat, nearly concave, and likewise finely haired vertex in the form of a median ridge, which is completely obliterated at the frontal margin.

The large oval eyes are simple in both sexes, the cornea covering them exhibiting no facets. The very large optic nerves, which, like cerebral hemispheres, occupy a great part of the head, nevertheless show very distinctly on their surface the ends of the numerous nervous filaments of which they are composed.

Behind the eyes, sunk in a pit of the cheeks, are the large three-jointed antennæ, the oval terminal joint of which is covered with fine setæ, and appears to be pierced on the upper and posterior side by a row of six oval attenuated spots, each of which is circumscribed by a thick ring. At its obtuse end this oval organ is attached by means of a long cylindrical stalk to the middle joint, which is of nearly the same size and of a clubbed hammer-shape; and this stalk is inserted in a circular orifice in the latter, within which it can be retracted. The delicate membranes above mentioned as closing the apparent orifices in the free oval terminal joint are protected from contact from without by means of long setæ curving over them, which spring from the hammer-like projection of the middle joint near the orifice already described. The very small ellipsoidal basal joint is inserted at one end into the upper posterior angle of the antennary pit, and at the other simply articulated to the second joint (Pl. VIII. fig. 2).

The three narrow but free thoracic segments, of which the posterior is partially concealed by the hinder margin of the preceding one, are somewhat dilated below, where they are pierced by a stigma which leads into a narrow trachea; with their lowest extremities they border the three immoveable epimera into which the coxæ are articulated.

The third or hindmost of these coxæ terminates below and anteriorly in the large and striking spinous process, to the discovery of which Guérin attributed great importance. The very powerful femur, which is united to this large posterior coxa by means of the trochanter, bears a series of strong bristles along the middle line of its outer surface. The first tarsal joint

of the posterior feet is fringed or pectinated at its lower edge with strong setæ; the broad coxæ and femora, which are sharp above and in front, are furnished with an emargination at the extremities of the side of flexion; from this the elastic tissue by means of which the projection of the animal is effected, projects in the form of a pad or cushion. (The form and garniture of the legs are shown in the figures of the animal in Plates VIII. and IX.).

In running, the two hind legs, which are then perfectly inactive, are drawn along; and only the four anterior feet move, in alternate pairs. In leaping, the animals only rise a few inches.

To the third or hindmost thoracic segment a pair of large, nearly triangular, wing-like plates, lying close to the body, are immoveably attached; in their broadest part, which occurs in the median line of the body, they attain nearly half the length of the abdomen. Like the segments of the body, they are uniformly chitinous. Between these two wing-like plates the middle of the first long but narrow dorsal half-segment is left uncovered.

No so-called second pair of wings is present, although there is a narrow lateral plate, which, like the wing, by which it is completely concealed, is attached to the posterior thoracic segment, and applies its upper and lower extremities to the margins of the narrow first dorsal and ventral half-segments. (This organ, with its stigma, is shown shining through the wing-lamina in Pl. VIII. fig. 3, and Pl. IX. fig. 1.) I cannot regard these organs as a second pair of wings, both on account of their immoveable attachment, with the first pair, to the third thoracic segment, and also on account of the occurrence of a stigma in their upper extremities, by which they show themselves to belong directly to the integument of the body.

Each of the two wing-like appendages of the third thoracic segment bears on its upper portion two rather distant, strong bristles, which are bent backwards. On some individuals I found exceptionally only one of these bristles.

A similar bristle springs on each side from each of the eight dorsal half-segments of the abdomen, of which the first, which is narrow, is not a complete half-segment; but the others, with the corresponding overlapping ventral half-segments, completely surround the abdomen.

Besides these complete chitinous half-segments, which are united by a delicate folded membrane, and overlap each other at the margins like the thoracic segments, there is, at the posterior extremity of the body, a number of plates more or less cleft and converted into variously formed appendages of the generative organs, according to the sex of the individual.

In the males the stigmata occur in the vicinity of the bristles,

a little before and underneath the latter. On the first seven abdominal segments these stigmata are narrow circular orifices, like those of *Pulex irritans*, which lead into equally narrow tracheæ, and are surrounded by a narrow six-celled margin (Pl. VIII. fig. 7). On the eighth or last complete half-segment there is a stigma, of six times the width of the others, opening into the cloaca, and surrounded by a circle of bristles, which converge over it and close the orifice (Pl. IX. figs. 1 & 2). The trachea of this stigma is about twice the diameter of the others, with which it unites on each side of the body to form a common longitudinal stem, from which branches are given off to the organs.

The tracheæ of the female are essentially different, both in number and arrangement, from those of the male; for in them, besides the great cloacal stigma with its very wide trachea (almost three times as large as the corresponding organ in the male), there are only three very wide tracheæ in the seventh, sixth, and fifth dorsal half-segments, with proportionately wide stigmata, which are very similar to the great cloacal stigma.

The large spines which converge over these wide stigmata of the female, as also over the cloacal stigma of the male, and protect the tracheæ from the intrusion of solid bodies, spring from the last tracheal annulus, the *peritrema* (Pl. VIII. figs. 3 & 6); whilst from the annuli of the lung-sac or dilatation of the neighbouring ends of tracheæ, similar spines, standing obliquely erect and reaching as far as the median line (such as are known to occur in *Lampyrus*), appear to assist in the attainment of this object.

The three next abdominal segments forwards have no stigmata in the females; but the short first dorsal half-segment attached to the third thoracic segment is furnished on each side with a small stigma analogous to those of the male, and the lateral plates described as lying under the wings are also, as already mentioned, provided with a similar stigma at the superior extremity.

In the female the three large lateral stigmata, like the seven narrow ones of the male, are situated so near the basal margins of the dorsal plates that they are covered by the posterior margins of the next plates, and are only recognizable by transmitted light, when they shimmer through the plate lying over them.

The four very wide cylindrical main tracheal stems on each side of the abdomen in the female divide each into two branches, one of which unites with the rest to form a stem running along the side of the abdomen, from which smaller branches are given off to the internal organs, which also receive ramifications of the second branch of the main stems.

It is remarkable that, during the parasitic existence of the female, its tracheæ entirely lose their peculiar spiral structure, and acquire considerably thickened walls; these changes take place first in the finer ramifications, and subsequently in the branches and stems, which, before the thickening becomes perfectly uniform, sometimes acquire a porous aspect. The cause of this extraordinary phenomenon, connected as it is with parasitic existence, is probably to be sought partly in the altered mode of nourishment and partly in the residence of the animal within the tissue, more or less permeated by fluids, of the living organism which furnishes the nutriment. On the one hand, by continual sucking, an extraordinary amount of fluid is taken up (if we may judge from the constant issue of lymph after unsuccessful operations, as already mentioned); and on the other hand, the evaporating surface of the animal is reduced to a minimum. The greater part of the integument of the parasite is entirely prevented from taking part in transpiration; those segments which contain the last stigmata transpire more or less incompletely, as even these segments have only a very small part directly exposed to the atmosphere. Perhaps this may be the cause of the considerable thickening both of the true air-passages themselves and also of these last abdominal segments; whilst the anterior and larger segments of the abdomen lose their chitinous plates by stretching them into very delicate membranes.

As I found no air in these altered and thickened tracheæ, it would almost appear as if these air-canals had suspended their normal functions during the parasitism of the insect—as if the tissue forming them vegetated on in an altered form independently of the developmental laws otherwise governing them, whilst the ovicells assimilated the unaltered lymph of the nutritive organism, which is continually brought to them by means of the sucking-apparatus acting by capillarity and adhesion. For the entire tractus intestinalis appears, as in chrysalides, to be subjected to a retrogressive metamorphosis; and the life of the animal during its parasitism, like that of many other endoparasites, seems to become purely vegetative.

Do the aëriferous tracheæ change their function in such a manner, during the residence of the animal in the tissues of the skin, that they are filled with lymph, instead of air, through the stigmata, and in consequence become thickened? This hypothesis, improbable enough in itself, is contradicted by the circumstances, that the last stigma of each side, which opens into the cloaca, is always freely exposed to the air, and that the stigmata concealed by the dermal tissues are not in the corium, but applied to the dry, horny epidermis (at least, the three pairs of

wide stigmata), and so closely that apparently neither air nor fluid can find its way into them; and, further, that in animals which had lived for some time in the skin I could find no fine tracheal ramifications of the ordinary spiral structure, whilst these must at least have remained in connexion with the cloacal stigma in case the want of access of air or the penetration of fluid had induced the alteration of structure in the anterior tracheæ.

In the animal in a free state, the alimentary canal shows the same complicated structure as in the *Pulices*. Whilst particular sections of it exhibit a greater delicacy, a greater development of the glandular appendages occurs; so that it would appear that the chylication of the food is rather effected chemically, whilst in *Pulex* mechanical arrangements assist in the operation. The latter applies especially to the nearly globular proventriculus, which, in *Pulex irritans*, is horny, folded, and internally almost spinose, whilst in *Rhynchoprion* it is simply membranous, and internally papillary glandular. Similar papillary glands occur in the large membranous true stomach of both species, especially in the vicinity of the anterior orifice. Before the crop, there is in *Rhynchoprion* a long muscular œsophagus, which appears to assist the passage of the inhaled nourishment into the stomach by powerful peristaltic movements; for it is always found constricted into a number of globular sections. At the commencement of the œsophagus there are two tufts of cylindrical salivary glands, each inserted by a common efferent duct; and instead of the small pedunculate pyriform glands, which in *Pulex* open into the intestine, as Malpighian vessels, in the vicinity of the pylorus, there are, in *Rhynchoprion*, two very long glandular tubes, which pour their contents by a common efferent duct into a region of the intestine which I cannot exactly particularize, as I never succeeded in observing these organs in connexion.

Of all these organs forming the tractus intestinalis, I could not with certainty detect anything in the dilated parasitic female—or, at least, I could recognize nothing with certainty—as any parts of the stomach and intestine that might have been present were so much softened as to lose all connexion during preparation.

That the ova, which now alone fill the much-dilated abdomen, and which have grown to an extraordinary size, are not, as stated by all previous observers, hatched in the body of the parent, is shown not only by the fact that fecundated ova are never found in the parasite, but also by the period of fecundation necessitated by the anatomical conditions.

The large ova, which grow to about half the length of the

unimpregnated animal (Pl. VIII. fig. 5), and in the outer pergamentaceous capsule of which there is at each end a group of small pores (the so-called micropyles), lie in the part of the ovary nearest to the vagina (Pl. VIII. fig. 12 *v*), and close to its efferent duct (fig. 12 *u*), without exhibiting the least sign of fecundation.

This efferent duct, which is common to the two ovarian tubes, opens into the fecundation-sac (fig. 12 *b*), formed of a delicate elastic membrane, into which the long afferent canal from the large seminal receptacle opens; the latter is filled with long filiform spermatozoids, which are not free in this receptacle, but each of them is rolled up singly in a spiral, and cemented into a small ellipsoidal corpuscle by a substance which is soluble in water. The pyriform seminal receptacle is composed of an elastic tissue, and is coated externally with striated muscular fibres and cellular tissue. If the seminal receptacle, taken from a recently killed animal, be torn under water, the small ellipsoidal spermatophores (fig. 10) with which it is filled break up, and from each of them is evolved a long seminal filament (fig. 11), which moves for some time in water.

It was found impossible to observe a mature ovum in the fecundation-sac; for, as soon as the operation of extracting a pregnant female from the skin is commenced, a large egg is usually projected from the cloaca, no doubt in consequence of the pressure exerted upon the insect. The fecundation-sac is therefore always found empty and collapsed (as here figured).

The natural process, in my opinion, is as follows:—The ripest ovum, impelled into the fecundation-sac by the pressure of the increasing ova behind it, meets there with some spermatozoids, which have previously been set free and migrated from the seminal receptacle; these fecundate it, excite in it the process of cell-formation, and induce the development of the embryo. In consequence of these processes, the egg begins to enlarge and to expand the elastic fecundation-sac, and it is finally expelled through the vagina in consequence of the pressure applied to it by the sac.

If the development of the larva in the one fecundated egg took place in the fecundation-sac or the oviduct, there would always, as in the *Pupipara*, be only one larva in the parasite; but the penetration of this larva into the nutritive body, associated as it would be with perforation of the walls of the mother, would prevent the natural development of all the other ova. For the position of the cloaca in the orifice of the epidermis produced by the penetration of the parasite, and immediately at the surface, would render it necessary, in order that the excluded larva might reach the mucous membrane, that it should

penetrate through the epidermis, upon which it must first of all get (which can hardly be regarded as probable); or else we must assume (as indeed is done by the majority of writers on this subject) that several larvæ are developed simultaneously in the ovary, and that these then break through the integuments of the mother and thus reach the inner parts of the skin. The anatomical characters above described do not accord with this assumption of viviparity.

The external sexual organs of the female consist of the cleft terminal abdominal segment, forming apparently two pairs, which preserve their form unchanged during the parasitic life of the animal, and surround the cloaca, which lies parallel to the surface of the skin, standing perpendicularly upwards.

In the male also (Pl. IX. figs. 1, 2, & 9) the last segments of the body are cleft, and of very peculiar form. Even in the still undivided seventh half-segment, the ventral lamina, which in general is somewhat less than the dorsal, is considerably smaller and almost canaliform (figs. 1, 2, & 6). Then follow two pairs of valvular or scale-like organs (fig. 6 *a*, *b*), each of which should probably be regarded as a cleft and metamorphosed dorsal or ventral plate. These laminæ serve as the coverings of the external organs of the generative apparatus (fig. 6; fig. 5, seen from above). Beneath the upper external valve (*a*) on each side a long-stalked forceps-like organ (*k*) is concealed, which evidently serves the male as an organ of support and adhesion during copulation. The branches of the forceps are shovel-shaped; the lower one moves upon the upper one by a broad two-armed hinge, and both are fringed round the anterior margin with long stiff bristles. The inferior pair of valves (*b*), which are longer than the upper, and clothed with short bristly hairs, cover the base of two long tubuliform channeled organs (*x*), open above throughout nearly their whole length. These have their inner margin recurved inwardly and notched, and by means of this are connected with another, central channeled organ (*z*) open beneath,—the lateral walls of this organ, which are likewise recurved inwardly at the middle part, being interlocked with them, whilst posteriorly they are rolled inwards and form two tubes for the reception of the two seminal canals (*v*). Two long narrow laminæ (*y*), with the upper margin undivided and the lower one emarginate in the middle, conceal this organ from above. During copulation, these laminæ bend downwards almost at a right angle from their narrow middle part (*e*), and thus no doubt serve to attach the two individuals to each other. The central channel (*z*), which is open below, has, on the lower surface of its decurved apex, a fine orifice, which evidently serves for the passage of the extremity of the long, round, filiform, but

tubular penis (*p*), which has its apex bent downwards. I found this organ once protruded from the rest of the generative apparatus in the manner shown in fig. 6, in a male engaged in the act of copulation; in another individual, in which it was likewise protruded, I found the apex broken off. This central channeled organ (fig. 6 *z*), which immediately encloses the penis, is engaged at its base in another channel open beneath, enclosed in the abdominal cavity of the animal, and the lateral walls of which are dilated anteriorly into broad, nearly rhombic laminæ (*p*), which can be drawn towards the anterior walls of the abdominal cavity by means of broad muscles (*m*).

In the bottom of this channel, turned towards the back of the animal, and between these two plates, is attached the long, slender, linear stem of a stirrup-shaped or two-armed and almost sledge-shaped body (*s*), directed towards the lower and anterior region of the body, upon which a muscle, attached to the posterior extremity of the abdominal cavity, is inserted. By means of these two muscles the entire sexual apparatus can be protruded and retracted.

The margins of the slender stem-like part (fig. 6 *c*) of this channeled chitinous organ are bent upwards, and thus again form on the inferiorly open channel a narrower channel open above on each side, in which the two multifariously twisted seminal cords (figs. 5 & 6 *v*) probably lie; these convey the long filiform spermatozoids produced in the testis (*g*) into the central channeled organ (*z*) in which the penis is concealed.

When the sexual apparatus is retracted, the canal of the seminal cords (*c*) forms with the sheath of the penis (*z*) an angle of 45°, turned upwards; the laminar extremity is situated in that region of the abdomen which is covered by the wing-plates. (It is shown through the integument in Pl. IX. fig. 1.) In fig. 6, to save room, it is shown in an oblique position, although truly, in the protruded condition of the external generative organs here delineated, the organs *c* and *z* form a still more obtuse angle.

From the form of the male sexual apparatus it follows that in copulation the female is not borne by the male, as in *Pulex irritans*, but that the female carries the male.

Besides this peculiarity, the different formation of the respiratory organs consequent on the parasitic mode of life, the different form of the maxillæ, and also the form of the palpiiform appendages of the cleft labium are the chief characters which warrant the separation of this insect from the genus *Pulex*, as the type of a peculiar generic group. The labium of *Pulex* is indeed equally deeply cleft; but its sections are not jointed as in our animal, but only pseudo-articulated by the chitinization of

different parts, whilst the long moveable terminal joint of each half of the labium in *Rhynchoprion* is not chitinous, and exhibits no division into joints.

EXPLANATION OF THE PLATES.

(The magnifying power is indicated near the number of each figure.)

PLATE VIII.

- Fig. 1.* A posterior leg and a portion of the tail of a Field-mouse, with several imbedded individuals of *Rhynchoprion*, brought by Schmarda from Peru.
- Fig. 2.* An antenna.
- Fig. 3.* A female animal before its parasitism: at *u* the entrance into the fecundation-sac is shown, and under the large wing-like organ the smaller lateral plate pierced by a stigma.
- Fig. 4.* A female after it has been imbedded in the skin for some days.
- Fig. 5.* A mature egg from the ovary, under the same power as the female in *fig. 3*: *m*, the micropyle.
- Fig. 6.* One of the large stigmata of the posterior dorsal half-segments of the female, with the neighbouring tracheal terminations.
- Fig. 7.* A stigma of the male, with a short trachea; magnifying power the same as for *fig. 6*.
- Fig. 8.* Head of the female (*fig. 4*), seen in front.
- Fig. 9.* A female that has attained its full development in the skin, seen in front.
- Fig. 10.* Spermatophora.
- Fig. 11.* The spermatozooids evolved therefrom, both taken out of
- Fig. 12.* The seminal receptacle, the efferent duct of which opens into the fecundation-sac (*b*), which is prolonged, on the one hand, into the efferent canal (*a*) of the ovary, and on the other into the vagina (*v*), with its mouth (*u*).
- Fig. 13.* A portion of a greatly thickened trachea of the parasitic female.
- Fig. 14.* Another greatly thickened tracheal branch, of which the inner originally spiral portion, which is now uniformly thickened, lies in the tenacious internal enveloping membrane.

PLATE IX.

- Fig. 1.* A male *Rhynchoprion*; the internal chitinous parts of the sexual apparatus indicated as shining through.
- Fig. 2.* The abdomen of an individual in which the sexual organs were protruded.
- Fig. 3.* A maxilla (*mx*), with the maxillary palpi (*t*), the mandible (*md*), the labium (*l*), and the mentum (*k*), drawn from the inside.
- Fig. 4.* The same, from the outside.
- Fig. 5.* The external parts of the sexual apparatus, seen from beneath, after the individual parts had been somewhat separated by a gentle pressure.
- Fig. 6.* The same parts, with the organs situated within the abdominal cavity, seen from the side (see p. 309).
- Fig. 7.* The labium, seen from beneath.
- Fig. 8.* Its lower part, seen from above.
- Fig. 9.* A male animal, seen from above.

Fig. 10. The anterior extremity of the median piercing-organ, seen from below.

Fig. 11. The same, seen from the side.

Fig. 12. The apex of a mandible, seen from the outside.

Fig. 13. The organs of the mouth separated by pressure, in connexion with the œsophagus (*o*) and one of the salivary glands opening into it (*g*), the proventriculus (*p*), the stomach (*s*), and the intestine (*d*).

Fig. 14. The median piercing-organ, seen from the side.

XXXIV.—*Notices of British Fungi.* By the Rev. M. J. BERKELEY, M.A., F.L.S., and C. E. BROOME, Esq.

[Plates XIX.—XVII.]

[Continued from vol. vii. p. 458.]

It will appear from the present notices that the Fungi of the British Isles are by no means exhausted, even as regards the more noble species. The Rev. G. H. Sawyer has opened out quite a new field in the neighbourhood of Ascot, where he has detected two important genera, *Sparassis* and *Rhizina*, together with several species not hitherto detected in Great Britain, besides rediscovering the long-lost *Helvella pannosa* of Sowerby. Mr. F. Currey has moreover detected a true *Nidularia*. Scotland, Wales, the West of England, and Warwickshire have also afforded such a good harvest as greatly to encourage further research, especially in those districts which have not hitherto been explored. Meanwhile the importance of this tribe of plants in an economical and nosological point of view is daily more generally recognized; so that we may consider the study rather in the ascendant, and may hope for new labourers in the field, in which we are glad to hail Mr. M. C. Cooke as a recent and valuable colleague.

986. *Agaricus* (*Amanita*) *spissus*, Fr. Ep. p. 9; Currey, in Linn. Tr. vol. xxiv. p. 151.

Combe Place, Lewes, F. Currey.

**A. (Lepiota) meleagris*, Sow. t. 171. This species came up abundantly in a hothouse at Coed Coch, Denbighshire, amongst spent tan, both in 1861 and during August of the present year, and is certainly a *Lepiota* closely allied to *A. clypeolaris*. Two forms occur which run into each other, the less typical of which has a campanulate obtuse pileus, and is of a darker tint when dry.

Pileus at first ovate or hemispherical, very obtuse, fawn-coloured, minutely tomentose and warty, then expanded, sub-campanulate, about 2 inches across, dotted with minute brown scales; stem at first fusiform, then nearly equal, of the same

colour, here and there tinged with yellow, most minutely squamulose, stuffed with cottony threads; ring soon ruptured, very fugacious; gills remote, distant, rounded behind, sometimes connected, white.

The whole plant changes in drying, or when cut, to a beautiful red. In the variety the gills are sometimes lemon-coloured.

987. *A. (Clitocybe) giganteus*, Fr. Ep. p. 67. Pileo infundibuliformi nec umbonato, adglutinato-flocculoso, albo, opaco; stipite æquali obeso; lamellis ex albo flaventibus, breviter decurrentibus.

In very rainy weather, on a grassy bank, Aboyne, Aberdeenshire, Aug. 15, 1862.

Pileus slightly viscid when moist, broadly infundibuliform, without any trace of an umbo, 9 inches across, white, opaque; margin incurved, at length sulcate; stem $2\frac{1}{2}$ inches high, an inch thick, equal, obtuse, minutely flocculose; gills at first very narrow, forked behind, decurrent, at length slightly rounded, white, then yellowish.

This is clearly the plant of Fries, and is, as he says, not very closely allied to *A. infundibuliformis*; whereas Sowerby's plant is so closely allied that it is difficult to separate the two. This moreover grows in more open places, whereas Sowerby's plant has occurred to us only in shady woods and plantations.

**A. (Clitocybe) maximus*, Fr. Ep. p. 67; Fl. Wett. p. 329; Sow. t. 244.

988. *A. (Mycena) marginellus*, Fr. Syst. Myc. vol. i. p. 113.

On fir-trunks, amongst *Hypnum cupressiforme*. Aboyne, Aberdeenshire, Aug. 11, 1862.

Pileus 3 lines across, conical, striate, pallid grey, darker in the centre, minutely rivulose; margin subcrenulate; stem short, slightly curved, shining, quite smooth, minutely fistulose; gills distant, slightly adnexed, white, with a purple margin.

Under a high magnifying power, the pileus (especially the edge) and stem appear clothed with minute glandular particles similar to those which colour the edge of the gills.

989. *A. (Mycena) flavo-albus*, Fr. Ep. p. 103. *A. pumilus*, Bull. t. 260.

On moss at the base of trunks of trees. Common.

This was formerly mixed up by Fries with *A. lacteus*, which is very common in fir-woods amongst fallen leaves. The description in 'English Flora' belongs to *A. flavo-albus*.

990. *A. (Mycena) rugosus*, Fr. Ep. p. 106; Bull. t. 518. K, M. On a prostrate oak. Bodelwyddan, Flintshire, Sept. 2, 1862.

Pileus at first campanulate, then convex, sulcate up to the umbo, cinereous, as well as the short compressed stem, which is glabrous above; gills distant, cinereous, uncinato-adnate, connected by veins.

991. *A. (Mycena) hæmatopus*, Pers. Obs. ii. p. 56.

On old dead trunks. Bodelwyddan, Flintshire, Sept. 2, 1863.

Tufted. Pileus moist, campanulate, then expanded, reddish, with a tinge of purple, $\frac{1}{2}$ –1 inch or more across, striate, very minutely rivulose; stem pale, rufous flesh-coloured, at first thickened at the base, then nearly equal, farinaceous; gills distant, adnato-subdecurrent, white; edge red; interstices even. Everywhere distilling, when broken, a dark-red juice. Far larger than any form of *A. sanguinolentus* or *A. cruentus*.

992. *A. (Mycena) cruentus*, Fr. Syst. Myc. vol. i. p. 149.

On fir-cones, Bodelwyddan, Bodryddan, Flintshire.

Pileus conic, obtuse, striate; margin inflexed, entire; substance at first rather thick in proportion. Stem rigid, smooth, full of red juice, strigose at the base. Gills obtuse in front, shortly adnate, white; margin of the same colour.

We are very glad to give this a certain place in our list, as the plant quoted by Fries from Sowerby is very doubtful.

993. *A. (Mycena) hiemalis*, Osbeck, Fr. Ep. p. 119.

On trunks of trees. Apethorpe, Norths., Nov. 23, 1863. Badminton, Gloucestershire.

A more delicate species than *A. corticola*.

994. *A. (Omphalia) affricatus*, Fr. Ep. p. 123.

On *Sphagnum*. Aboyne, Aberdeenshire, at the top of the Queen Hill, Aug. 9, 1862.

Pileus $\frac{3}{4}$ inch across, infundibuliform or deeply umbilicate, hygrophanous, brown, then mouse-coloured, minutely virgate. Stem compressed, tomentose at the base. Gills distinct, distant, ending abruptly, decurrent.

995. *A. (Pleurotus) corticatus*, Fr. Mon. Hym. Suec. p. 236.

On an old prostrate elm. Belvoir Castle, Oct. 24, 1861.

A large and noble Agaric, perhaps too closely allied to *A. dryinus*.

Pileus excentric, 7 inches across, expanded, swollen in the centre; disk, especially in the centre, broken up into brownish-grey silky scales, which are more minute towards the thin strongly involute margin; veil woven, adhering slightly to the stem and margin. Stem 3 inches high, $1\frac{1}{2}$ inch thick, pitted and silky below the evanescent ring, firm and tough, mottled. Gills rather broad, pure white, very decurrent, anastomosing behind, sometimes forked; edge entire. Smell rather strong.

996. *A. (Pleurotus) lignatilis*, Pers. Syn. p. 368; Fl. Dan. t. 1797.

On beech-trees. Burnham Beeches, abundant in 1863. First discovered by the Rev. G. H. Sawyer.

The specimens agree precisely with the Flora Danica figure.

997. *A. (Pleurotus) serotinus*, Schrad. Spic. p. 140.

On trunks of trees. Jedburgh, A. Jerdon. Bowood, on beech, C. E. Broome.

998. *A. (Entoloma) majalis*, Fr. Syst. Myc. p. 205.

Coed Coch, Denbighshire, Mrs. Wynne.

999. *A. (Entoloma) ameides*, n. s. Pileo irregulari, late campanulato gibbo, centro polito; margine albo-flocculento, demum glabro, sericeo-nitente, undulato: stipite farcto, compresso, basi albo villosa, sursum striato fibrilloso, apice flocculento: lamellis distantibus leviter adnexis rugosis.

In pastures. Bodelwyddan, Flintshire, Sept. 1863.

Pileus 1-2½ inches across, varying from hemispherical in smaller specimens to campanulate, thin, pale reddish grey; spores rose-coloured, irregular. Large specimens, at first sight, closely resemble *Hygrophorus ovinus*. Smell peculiar, resembling a mixture of orange-flower water and starch. The whole plant acquires a reddish tint in drying. We can find no record of anything at all near it.

1000. *A. (Clitopilus) undatus*, Fr. Ep. t. 149.

In open downs. Batheaston, &c., C. E. Broome, Oct. 1863.

1001. *A. (Eccilia) carneo-griseus*, n. sp. Pileo umbilicato carneo-griseo striato subtiliter punctato, margine particulis obscuris miculato; stipite gracili concolori nitido glabro, basi albo tomentoso, sursum fibroso-cavo; lamellis distantibus adnato-decurrentibus subundulatis roseis, margine irregulari obscuriore.

Amongst fir-leaves. Aboyne, Aberdeenshire, Aug. 8, 1862.

A true *Eccilia*. Spores irregular, rose-coloured. Its closest ally is *A. atrides*, from which it differs in the smooth stem, delicate colour, &c.

PLATE XIII. fig. 1. *a. A. carneo-griseus*, nat. size; *b.* vertical section of ditto; *c.* spore, magnified.

1002. *A. (Pholiota) leochromus*, Cooke, in Seemann's Journ. of Bot. 1863, p. 65, t. 3. f. 3.

On elder-stumps, near London.

Mr. Cooke has indicated the points in which this and the following species differ from *A. pudicus*. All the three are Southern forms. It is probable that this is the tawny form *b. fulvellus*, Fr., figured by Bulliard in the same plate with the true *A. pudicus*.

1003. *A. (Pholiota) capistratus*, Cooke, l. c. tab. 3. f. 4.

On old stumps of elm, &c. Highgate.

The involute margin and decurrent gills distinguish this species from its allies; besides which it does not appear to be esculent like *A. pudicus* and *A. leochromus*.

1004. *A. (Hebeloma) euthelus*, n. sp. Pileo expanso fortiter

umbonato subundulato cervino sericeo-nitente subsquamuloso ; stipite subæquali pallido striatulo solido fibroso ; lamellis pallidis albo marginatis denticulatis adnatis.

On the ground, amongst fir-leaves. Aboyne, Aberdeenshire, Aug. 19, 1862.

Smell farinaceous, rather disagreeable. Spores even, sub-elliptic, .00029 inch long.

It differs from *A. fastigiatus* in the adnate gills, smooth, not rough, spores ; and from *A. Curreyi*, with which it agrees as to the spores, in its strongly umbonate pileus, nearly equal stem, and adnate gills.

PLATE XIII. fig. 2. *a. A. Euthelus*, nat. size ; *b.* vertical section of do. ; *c.* spores highly magnified.

1005. *A. (Hebeloma) vatricosus*, Fr. Ep. p. 177.

On dead stumps. Bodelwyddan, Flintshire, Sept. 2, 1863.

Before the veil is ruptured, it looks like a smooth *Lepiota*. An excellent drawing of this species has been sent to us by Fries.

1006. *A. (Flammula) sapineus*, Fr. Syst. Myc. vol. i. p. 239.

On fallen branches of Scotch fir, and chips and sawdust about a saw-pit. Aboyne, Aberdeenshire, Aug. 1863.

Our plant agrees exactly with the figure in Persoon's Ic. et Descr. t. 4. fig. 7. The species, as Fries says, is extremely variable, especially as to the breadth and mode of attachment of the gills. It is a very interesting addition to our flora, and remarkable, like *A. spectabilis*, for the bright colour of the spores.

1007. *A. (Naucoria) sideroides*, Bull. t. 588.

On the trunk of an ash-tree. Apethorpe, Norths., Nov. 23, 1863, with *Agaricus hiemalis*.

Probably common. Much thicker than *A. hypnorum*, which it somewhat resembles.

1008. *A. (Galera) Sphagnorum*, Pers. Syn. p. 385 ; Bull. t. 560. H.

On *Sphagnum* on the borders of a pine-wood. Aboyne, Aberdeenshire, Aug. 1862.

1009. *A. (Psalliota) elvensis*, n. s. Cæspitosus ; pileo e subglobo hemisphærico fibrilloso in squamas magnas fuscas diffracto, medio areolato, margine crasso pyramidali-verrucoso ; stipite deorsum fibrilloso, annulo amplissimo subtus areolato-verrucoso ; lamellis liberis carneo-fuscis.

Under oak trees. Bodelwyddan, Sept. 2, 1863.

Tufted. Pileus at first subglobose, then hemispherical, 6 inches or more across, fibrillose, broken up into large persistent brown, not fusco-citrinous, scales, areolate in the centre ; margin very obtuse, thick, covered with pyramidal warts ; stem at first nearly

equal, at length swollen in the centre, and attenuated at the base, 4 inches high, 2 inches thick in the centre, fibrillose and areolate below, nearly smooth within the pileus, solid, stuffed with delicate threads; ring thick, very large, deflexed, broken here and there, areolato-verrucose beneath; gills $\frac{1}{4}$ inch broad, free, of a brownish flesh-colour.

Flesh of pileus $\frac{3}{4}$ inch thick in centre, turning red when cut. Taste and smell excellent.

Nearly allied to *A. augustus*, but differing in colour, its stuffed areolate stem, warty margin, &c. It is one of the most magnificent fungi. The specific name refers to the district bordering on the river Elwy, in which it was so magnificently developed.

**A. (Hypholoma) velutinus*, Pers. Syn. p. 409; b. *leiocephalus*.

Pileus hygrophanous, rugged, smooth except at the margin, where it is fibrillose, pallid as is the stem, whose apex is farinose.

On old stumps at Bodelwyddan, Flintshire, Sept. 2, 1863.

Densely cæspitose; much smaller than the common form, but apparently a mere variety, though a very striking one, from its smooth but very rugged disk.

1010. *A. (Psathyra) pennatus*, Fr. Syst. vol. i. p. 297.

On naked soil in gardens. King's Cliffe occasionally, but never in any abundance.

1011. *Coprinus similis*, n. s. Pileo ovato-campanulato lineato-striato pallido, centro obscuriore hygrophano, verrucis acutis apice fuscis secedentibus vestito; stipite cavo, albo, basi latiore; lamellis adnatis, postice attenuatis, sublinearibus, prope marginem brunneolis.

On trunks of dead trees. Bodelwyddan, Flintshire, Sept. 2, 1862.

Resembling *C. aphthorus*, but differing in the striate pileus, &c.

1012. *Cortinarius (Phlegmacium) fulgens*, Fr. Ep. p. 267.

Bathford Down, Sept. 1863, C. E. Broome.

1013. *Hygrophorus arbustivus*, Fr. Ep. p. 323.

Wiltshire, Dec. 1864, C. E. Broome.

1014. *Russula chamæleontina*, Fr. Obs. i. no. 89.

In woods, King's Cliffe, Sept. 30, 1863.

1015. *Lactarius pubescens*, Schrad. Spic. p. 122. Var. marginem tomentosus.

In pastures. Aboyne, Aberdeenshire, Aug. 1862.

Pileus 2 inches across, depressed, clothed with fine matted down; margin involute, tomentose; flesh firm; stem nearly equal, $1\frac{1}{4}$ inch high, about 5 lines thick, smooth, pale flesh-coloured; gills thin, scarcely branched; milk extremely acrid, white, not changeable; odour pungent.

We have little hesitation in referring this to *L. pubescens*, though the margin is tomentose rather than fibrillose—a circumstance scarcely sufficient to justify us in considering it as an undescribed species. It seems to be just what Krombholz figures at tab. 13. figs. 1, 2.

1016. *L. cyathula*, Fr. Syst. Myc. p. 66.

In woods. Aboyne, Aberdeenshire, Aug. 1862.

Pileus plane, at length depressed or infundibuliform, $1\frac{1}{2}$ –2 inches across, opaque, slightly viscid, obtuse or obscurely umbonate, somewhat zoned, of a pallid flesh-colour; stem spongy, stuffed, $1\frac{1}{2}$ –2 inches high, $\frac{1}{3}$ inch thick, nearly equal, at length compressed, shining with a silky aspect; gills narrow, crowded, of a yellowish flesh-colour, subdecurrent; milk white, not changing colour, at length acid; smell somewhat like that of bugs.

**Cantharellus cinereus*, Fr. Syst. Myc. p. 320.

Burnham Beeches, Rev. G. H. Sawyer. Hampshire, Mrs. Wynne. In both cases abundantly. Not gathered before in England since the time of Bolton.

1017. *Marasmius languidus*, Fr. Ep. p. 379. (Pers. Myc. Eur. iii. p. 110, t. 26. fig. 6.)

Coed Coch, Denbighshire. On dead leaves of grass.

The specimens agree very closely with *A. grossulus*, Pers., quoted above, the gills being more decurrent than in the typical form. Persoon, in the text, quotes fig. 2, not fig. 6; but it is clearly a slip of the pen.

1018. *M. angulatus* (*A. angulatus*, Pers. Myc. Eur. iii. p. 155, tab. 26. f. 3, 4).

On grass. Cefn, Denbighshire, just above the Bone-cave.

Very different from *M. Vaillantii*, to which Fries refers it.

1019. *Lentinus fimbriatus*, Curr. l. c. p. 151, tab. 25. f. 2.

On a stump in a pond. Lewes, F. Currey.

1020. *Boletus varicolor*, n. s. Pileo convexo subtomentoso olivaceo, margine involuto; carne sub cute atro-purpureo; stipite bulboso sursum attenuato apice reticulato, deorsum lutescente, sursum rufescente subtiliter pubescente; tubulis minutis liberis luteis.

Deeside, Aberdeenshire, Aug. 11, 1862.

The flesh of the pileus and stem is pale, here and there inclining to yellow, and partially marbled.

This species is just intermediate between the sections *Subtomentosi* and *Calopodes* of Fries, approaching *B. subtomentosus* in habit, but with the bulbous reticulated stem of the latter.

PLATE XIII. fig. 3. a. *B. varicolor*, nat. size; b. section of ditto.

**B. cyanescens*, Bull. t. 369.

Mr. Cooke has lately met with this interesting species on the

road leading from Nealishead to Irstead, Norfolk, Sept. 26, 1864. Its claims to a place in the British Flora rested previously on the authority of Sibthorpe alone.

1021. *Polyporus* (Resupinati) *violaceus*, Fr. Syst. Myc. vol. i. p. 379.

On prostrate fir poles. Aboyne, Aberdeenshire.

Allied to *Merulius*, for which a young specimen might easily be taken. The figure of *P. purpureus* in Rostkovius is an excellent representation of our plant; but that species turns quite pale when dry, as in an authentic specimen from Fries.

1022. *P.* (Resupinati) *subfuscus-flavidus*, Rostk. in Sturm, no. 27. tab. 11.

On oak planks in the roof of King's Cliffe Church.

The pores appear, when viewed one way, of a greyish brown, and the other white. The species appears to be the same with one received from Lindblad, marked "*Pol. n. s.*"; and if we had not a supreme dislike to alter names, we should propose the name of *P. Lindbladii* instead of the barbarous name given above from Rostkovius.

**P.* (Resupinati) *hybridus*, B. & B., Outl. British Fungi, p. xvii.

This species does not, as Fries supposes, belong to *Anodermei*; much less is it identical with *P. fragilis*.

**P.* (Resupinati) *vaporarius*, Fr. Var. *secernibilis*, *candidus*, *exsiccatus melleus*.

A very remarkable variety of this (if it may be called a variety) occurred with *Hydnum niveum*, at Ascot, creeping over fir-leaves and heath-twigs quite shaded from the light, and differing from the common form in being of a pure white when fresh, changing, when dry, to honey-yellow. The subiculum is filmy and separable; but we find states of *P. vaporarius* which approach it so closely in this respect that we cannot detect any good distinctive character.

1023. *P.* (Resupinati) *Gordoniensis*, n. sp. Effusus, superficialis, membranaceus, tenuissimus sed secernibilis, persistenter candidus, margine breviter fimbriato; poris minutis inæqualibus angulatis, dissepimentis tenuissimis fimbriato-dentatis.

On fir poles. Aboyne Castle, Aberdeenshire.

An extremely delicate species, and not in the slightest degree innate. The margin remains snow-white, and the pores themselves change colour only very slightly in drying.

1024. *Hydnum fragile*, Fr. Mon. Hym. Succ. vol. ii. p. 274; Bergeret, vol. i. t. 13, p. 97.

Amongst heath, Ascot, where it was pointed out to us by the Rev. G. H. Sawyer, mixed with enormous specimens of *Hydnum imbricatum*.

This fine species, which attains a diameter of several inches, was included, in the 'Syst. Myc.,' under *H. lævigatum*, from which it is now very properly separated. We have fine specimens of the true plant from Italy.

1025. *Hydnum tomentosum*, L. Suec. 1259.

Ascot, in fir-woods. Abundant, Rev. G. H. Sawyer.

Our specimens exactly resemble one from Fries, marked *H. tomentosum*, var. They have a strong scent of melilot, but differ from *H. graveolens* in the strongly zoned pileus, more coriaceous substance, and in the white (not grey) spines. The white spores are thrown down in abundance on any subjacent objects.

**H. zonatum*, Fr., Batsch, El. f. 229.

Ascot, Rev. G. H. Sawyer.

A small variety; remarkable for an appearance in the spines like that of shot silk. Spores ferruginous.

1026. *H. argutum*, Fr. Syst. Myc. vol. i. p. 424.

Bodelwyddan, Flintshire, Sept. 1863. Twycross, Rev. A. Bloxam, on a willow, extending over a large surface.

The plant from Flintshire is the more normal form. Mr. Bloxam's plant agrees in everything with *Sistotrema laxum*, Pers. Myc. Eur., referred by Fries to this species, except in the teeth not being serrated. The more distinctive character, however, seems to reside in the spongy subiculum, which consists of rather strong perpendicular threads. The spores are large and subglobose.

**H. niveum*, Pers. Syn. p. 563. Var. *persistenter niveum*.

Ascot, running over shaded twigs of heath near the ground, in little membranaceous films.

Teeth compressed. This does not become so yellow in drying as specimens from other localities; but it does not seem to differ essentially. The patches are only a few lines across.

1027. *Grandinia ocellata*, Fr. Ep. p. 527.

On dead prostrate trunks of trees. Bodelwyddan, Flintshire; Coed Coch, Denbighshire, Aug., Sept., 1863, 1864.

**Thelephora Sowerbeii*, B. Outl. p. 266. *Nivea infundibuliformis*, tandem decolorans, sursum aculeato-scabra; hymenio esetuloso.

Mr. Sawyer has at last met with the true plant of Sowerby at Burnham Beeches, where it has since been seen by others. When fresh, it is of a pure white; though, when exposed to the weather, it assumes a dingy yellow tinge here and there, and therefore cannot be the same with the Cotterstock plant described below, of which we now give a figure. The hymenium is not in the slightest degree setulose. The pileus is rough, with radiating processes projecting from the surface. Sowerby's

figure was evidently taken from discoloured specimens, but is very faithful.

1028. *T. multizonata*, n. s. Pileo multiplici infundibuliformi e variis lobis stipitibusque confluentibus oriundo, sursum læte carneo-rufo multizonato, margine lobato-crenulato; hymenio costulato pallidiore glabro. *T. Sowerbei*, Eng. Fl., in part.

Forming a dense mass, of a beautiful reddish tint; flesh and stem zoned within.

This species is perfectly distinct from Sowerby's plant, and has not, we believe, been noticed by any continental botanist. Our figure will prevent any confusion for the future.

PLATE XIII. fig. 4. *Thelephora multizonata*, B. & B., nat. size.

1029. *Corticium evolvens*, Fr. El. i. p. 181.

On a dead double cherry, in great abundance. King's Cliffe, Jan. 1864.

1030. *Sparassis crispa*, Fr. Syst. Myc. vol. i. p. 465.

Amongst heath. South-east Berkshire, between the Asylum for Criminals and the Wellington College, Rev. G. H. Sawyer.

For an account of this noble addition to our list, we beg to refer to the 'Intellectual Observer,' No. 25, page 1 (cum icone).

1031. *Clavaria formosa*, Pers. Ic. et Descr. t. 3. f. 6. Bathford Down, C. E. Broome.

Spores buff, broadly fusiform, granulated.

1032. *Calocera stricta*, Fr. Ep. p. 581.

On ash. Belvoir Castle, Oct. 1862.

This differs from *Calocera cornea* in its scattered mode of growth and slender habit. Occasionally two individuals grow from the same spot; but they are never broadly confluent at the base, as in the common species.

**Melanogaster ambiguus*, Tul. Fung. Hyp. tab. 2. f. 5.

This species has been found near Jedburgh by Mr. Jerdon—a circumstance worth recording, as so few Hypogæous Fungi have hitherto occurred in Scotland.

1033. *Bovista ammophila*, Lév. Ann. d. Sc. Nat. sér. 3. tab. 9. fig. 5.

On the side of a wood at Cefn Meiriadoch, Denbighshire, on the road leading from Pont Newydd, Sept. 1864.

Exactly according with Léveillé's figure and description.

1034. *Badhamia inaurata*, Curr. l. c. p. 156, fig. 8.

On Jungermannia, Pett's Wood, Paul's Cray Common, Oct. 1859, F. Currey.

1035. *Didymium serpula*, Fr. Syst. Myc. vol. iii. p. 126.

On dead plane-leaves. Batheaston, C. E. Broome, March 1864.

1036. *Cribraria argillacea*, Pers. Obs. i. p. 90; Schrad. Nov. Gen. figs. 1, 2.

On decayed branches and stumps of Scotch fir. Aboyne, Aberdeenshire, 1862.

Forming broad confluent patches, pouring out a large quantity of clay-coloured dust. The least beautiful of the genus, though, when cleared from the spores, the plant is a pretty object under the microscope.

1037. *C. aurantiaca*, Fr. Syst. Myc. vol. iii. p. 174.

On decayed branches of Scotch fir. Aboyne, Aberdeenshire, with *Ceratium*, 1862.

Far less abundant than the last, and a very pretty though minute species.

[To be continued.]

XXXV.—On some New Genera of Mollusca from the Seas of Japan. By ARTHUR ADAMS, F.L.S., &c.

Genus MITROMORPHA, A. Ad.

Testa elongato-fusiformis, utrinque acuminata; anfractibus planis, transversim liris. Apertura angusta; columella recta, leviter transversim lirata; labro acuto, intus lævi, postice vix sinuato.

Like the *Cancilla* form of *Mitra*, but without any trace of plaits on the columella. By some it would be considered a mitriform *Daphnella*, which it certainly is. In shape it also resembles the subgenus *Genota*, but not in texture or surface. *Dibaphus* and certain Cones also suggest themselves when the characters of this shell are regarded.

Mitromorpha lirata, A. Ad.

M. testa subalbida aut pallide fusca, mitriformi, utrinque acuminata, spira aperturam æquante; anfractibus normalibus 5, convexis, transversim liris, liris subconfertis æqualibus æquidistantibus; apertura angusta, labio recto, simplici, plica unica inconspicua antice instructo; labro intus lævi, margine crenulato; columella antice arcuatim truncata.

Hab. Simonoseki; Seto-Utchi.

The two or three nucleolar whorls are smooth, like those in *M. filosa* from Santa Barbara, described by Dr. Carpenter. A variety or allied species has the whorls longitudinally plicate, and some of the transverse liræ corrugate or undulated.

Genus CYTHAROPSIS, A. Ad.

Testa fusiformis, utrinque acuminata, *Cytharæ* formi; anfractibus convexis, costellis longitudinalibus et liris transversis cancellatis. Apertura angusta, columella transversim sulcata; labro extus vari-

coso, intus valde lirato, postice leviter sinuato, canali antice subproducto, acuminato, ad sinistram inclinato.

Unable to refer this shell to any established genus, and my scientific friends failing to assist me, I have ventured upon giving it generic rank. It is an elegant cancellated shell, resembling in form some of the more slender species of *Cythara*. From all the species of that genus, however, it differs in the recurved canaliculate aperture and in the cancellation of the surface.

Cytharopsis cancellata, A. Ad.

C. testa utrinque acuminata, rufescente, spira aperturam æquante; anfractibus convexis, costellis longitudinalibus et liris transversis confertis eleganter cancellatis, anfractu ultimo antice producto et acuminato.

Hab. Mino-Sima, 63 fathoms.

Among the *Pleurotoma* tribe, this very elegant form most nearly approaches *Genota*; but in that *Mitra*-like shell the outer lip is not variced, nor is the surface cancellated. I dredged the young of this species also in 54 fathoms' water off the island of Quelpart; so that it does not appear to be limited to the Sea of Japan.

Genus *CROSSEA*, A. Ad.

Testa turbinata, umbilicata, alba. Anfractus convexi, cancellati, simplices aut varicibus instructi. Apertura orbiculata, antice in angulum canaliculatum producta; umbilico callo funiformi coarctato et circumcincto.

The singular and beautiful little shells which I have here dedicated to the able and zealous conductor of the 'Journal de Conchyliologie' have perhaps the closest affinity with *Cirsotrema*, Mörch, a genus of *Scalidæ*. They also remind one of *Torinia* with regard to the peculiar cord-like callus which encircles the umbilicus, and in their form and cancellation they very much resemble some of the species of *Conradia*. A great peculiarity consists in the canaliculate angular projection at the fore part of the aperture.

1. *Crossea miranda*, A. Ad.

C. testa elongato-turbinata, candida; anfractibus convexis, spiraliter liratis, interstitiis cancellatis, varicibus longitudinalibus (3-4) distantibus prominentibus instructis; umbilico cingulo funiformi succincto; labro extus fimbriato-varicoso.

Hab. Gotto Islands, 64 fathoms.

2. *Crossea bellula*, A. Ad.

C. testa depresso-turbinata, alba; anfractibus spiraliter liratis, inter-

stitiis cancellatis, varicibus nullis; umbilico callo funiformi circumcincto; labro extus simplici, margine acuto.

Hab. Gotto Islands, 64 fathoms.

Genus *LAONA*, A. Ad.

Testa semiovata, tenui, rimata, striis incrementi lamellosis rugosa; spira celatæ; anfractu ultimo magno rotundato. Apertura ampla, obliqua, rotundato-ovalis; labio recedente arcuato; labro simplici.

The British *Bulla pruinosa* belongs to the same group, which offers the peculiarity of a decussate surface. The form of the shells also is so different from that of any other division of *Bullidæ*, that I consider it desirable to point out the significance of these shells by giving them a distinctive name. The animal is unknown.

Laona zonata, A. Ad.

L. testa sordide alba, fasciis duabus transversis latis rufo-fuscis ornata, lamellis longitudinalibus confertis tenuibus crenellatis et striis concentricis decussata.

Hab. O-Sima; Yohuko.

BIBLIOGRAPHICAL NOTICES.

Ootheca Wolleyana. Part I. Edited by ALFRED NEWTON, M.A. &c. Van Voorst, 1864.

UNDER the modest title of a catalogue, or list, of the contents of the egg-chest of the late John Wolley, Mr. Alfred Newton has brought together and arranged a great number of valuable observations made by his late friend.

We need hardly remind our readers that Mr. Wolley was a most zealous and accurate ornithologist, and was especially successful in discovering the breeding-quarters of many of the rarest European birds. His labours were especially directed to the exploration of the north-eastern portion of Arctic Europe, Lapland, &c., from which he used to bring back, year by year, a store of most interesting observations and spoils to gladden the eyes of many a fellow-ornithologist, and to enrich many collections with birds in a state of plumage hardly known before. We rejoice to hear that the exploration of this interesting district is still being carried on by Mr. Newton, who seems to have inherited not only the collections, but the mantle of Wolley.

Wolley was a model naturalist. To the untiring energy and fond observation of a Waterton he added the critical exactness of a scholar; and thus, in his short life, he probably did more for European ornithology than any other living naturalist. Mr. Newton has found congenial employment in editing and revising (with additions) the memoranda of his friend; and we have only to say, with

regard to the present handsome volume, that it is a monument at once worthy of the naturalist whose name it bears and creditable to his literary executor, who has shown excellent judgment in his selection of matter, and good taste in the illustrations, of which latter it is only needful to observe that they are from the pencils of Hewitson and Wolf.

To all oologists the 'Ootheca' will be indispensable.

Catalogue of the Mammalia in the Collection of the Australian Museum. By GERARD KREFFT, Curator and Secretary. Sydney : printed by order of the Trustees. 1864.

This Catalogue is prepared on the model of Dr. Gray's 'List of Mammalia in the British Museum.' Indeed it is almost a facsimile in form and appearance, with the addition of a few notes on the habits of some of the more recently discovered species, the description of three or four which Mr. Krefft thinks had not been described before, a synopsis of the dental formula of each genus, and some short directions for the preservation of specimens. Considerable attention is paid to the local names which are given to the animals in the different districts of Australia which they inhabit.

We may give the following as a specimen of the notes that it contains. Under *Phascogale penicillata*, Mr. Krefft observes—"The female is not provided with any visible pouch; the number of mammae is ten, and as many young are occasionally brought forth, though probably not more than four or five reach maturity." After quoting Mr. Gould's account of its habits, he proceeds—"As I have frequent opportunities of observing this animal, I am able to state that Mr. Gould's charges as to its depredations are quite unfounded, as it is a truly insectivorous animal, which may, indeed, occasionally capture a small bird or a mouse. When it has taken up its quarters in a store, the owner can derive benefit only from its presence, as it destroys cockroaches and other insects, and soon clears the place of smaller rodents, though it is no match for a rat" (p. 29).

The collection consists of 283 species, thus divided :—Primates 45, Feræ 62, Marsupialia 59, Rodentia 57, Edentata 7, Pachydermata 7, Ruminantia 35, Cete 11.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

Dec. 15, 1864.—J. P. Gassiot, Esq., Vice-President, in the Chair.

"On the Structure and Affinities of *Eozoon Canadense*." In a Letter to the President. By W. B. Carpenter, M.D., F.R.S.

I cannot doubt that your attention has been drawn to the discovery announced by Sir Charles Lyell in his Presidential Address at the late Meeting of the British Association, of large masses of a fossil organism referable to the Foraminiferous type, near the base

of the Laurentian series of rocks in Canada. The geological position of this fossil (almost 40,000 feet beneath the base of the Silurian system) is scarcely more remarkable than its zoological relations; for there is found in it the evidence of a most extraordinary development of that Rhizopod type of animal life which at the present time presents itself only in forms of comparative insignificance—a development which enabled it to separate carbonate of lime from the ocean-waters in quantity sufficient to produce masses rivalling in bulk and solidity those of the stony corals of later epochs, and thus to furnish (as there seems good reason to believe) the materials of those calcareous strata which occur in the higher parts of the Laurentian series.

Although a detailed account of this discovery, including the results of the microscopic examinations into the structure of the fossil which have been made by Dr. Dawson and myself, has been already communicated to the Geological Society by Sir William E. Logan, I venture to believe that the Fellows of the Royal Society may be glad to be more directly made acquainted with my view of its relations to the types of Foraminifera which I have already described in the Philosophical Transactions.

The massive skeletons of the Rhizopod to which the name *Eozoon Canadense* has been given, seem to have extended themselves over the surface of submarine rocks, their base frequently reaching a diameter of 12 inches, and their thickness being usually from 4 to 6 inches. A vertical section of one of these masses exhibits a more or less regular alternation of calcareous and siliceous layers, these being most distinct in the basal portion. The specimens which the kindness of Sir William E. Logan has given me the opportunity of examining are composed of carbonate of lime alternating with serpentine—the calcareous layers being formed by the original skeleton of the animal, whilst the serpentine has filled up the cavities once occupied by its sarcode-body. In other specimens the carbonate of lime is replaced by dolomite, and the serpentine by pyroxene, Loganite, or some other mineral of which siliceous is a principal constituent. The regular alternation of calcareous and siliceous layers which is characteristic of the basal portion of these masses, frequently gives place in the more superficial parts to a mutual interpenetration of these minerals, the green spots of the serpentine being scattered over the surface of the section, instead of being collected in continuous bands, so as to give it a granular instead of a striated aspect. This difference we shall find to depend upon a departure from the typical plan of growth, which often occurs (as in other Foraminifera) in the later stages—the minute chambers being no longer arranged in continuous tiers, but being piled together irregularly, in a manner resembling that in which the *cancelli* are disposed at the extremities of a long bone.

The minute structure of this organism may be determined by the microscopic examination either of thin transparent sections, or of portions which have been submitted to the action of dilute acid, so as to remove the calcareous shell, leaving only the siliceous *casts* of the chambers and other cavities originally occupied by the substance of the animal. Each of these modes of examination, as I have

shown on a former occasion*, has its peculiar advantages; and the combination of both, here permitted by the peculiar mode in which the *Eozoon* has become fossilized, gives us a most complete representation not only of the skeleton of the animal, but of its soft sarcod-body and its minute pseudopodial extensions as they existed during life. In well-preserved specimens of *Eozoon*, the shelly substance often retains its characters so distinctly, that the details of its structure can be even more satisfactorily made out than can those of most of the comparatively modern *Nummulites*. And even the hue of the original sarcod seems traceable in the canal-system; so exactly does its aspect, as shown in transparent sections, correspond with that of similar canals in recent specimens of *Polystomella*, *Calcarina*, &c. in which the sarcod-body has been dried.

This last circumstance appears to me to afford a remarkable confirmation of the opinion formed by Mr. Sterry Hunt upon mineralogical grounds—that the siliceous infiltration of the cavities of the *Eozoon* was the result of changes occurring *before* the decomposition of the animal. And the extraordinary completeness of this infiltration may be the result (as was suggested by Professor Milne-Edwards with regard to the infiltration of fossil bones and teeth, in the course of the discussion which took place last year on the Abbeville jaw) of the superiority of the process of *substitution*, in which the animal matter is replaced (particle by particle) by some mineral substance, over that of mere *penetration*.

The *Eozoon* in its living state might be likened to an extensive range of building made up of successive tiers of chambers, the chambers of each tier for the most part communicating very freely with each other (like the secondary chambers of *Carpenteria*†), so that the segments of the sarcodic layer which occupied them were intimately connected, as is shown by the continuity of their siliceous models. The proper walls of these chambers are everywhere formed of a pellucid vitreous shell-substance minutely perforated with parallel tubuli, so as exactly to correspond with that of *Nummulites*, *Cyclodolopeus*, and *Operculina*‡; and even these minute tubuli are so penetrated by siliceous infiltration, that when the calcareous shell has been removed by acid, the internal casts of their cavities remain, in the form of most delicate needles standing parallel to one another on the solid mould of the cavity of the chamber, over which they form a delicate filmy layer.

But, between the proper walls of the successive tiers of chambers, there usually intervene layers of very variable thickness, composed of a homogeneous shell-substance; and these layers represent the “intermediate” or “supplemental” skeleton which I have described in several of the larger FORAMINIFERA, and which attains a peculiar development in *Calcarina*§. And, as in *Calcarina* and other recent and fossil FORAMINIFERA, this “intermediate skeleton” is traversed by a “canal-system” || that gave passage to the prolongations of the

* Memoir on *Polystomella*, in Phil. Trans. for 1860, pp. 538, 540.

† Phil. Trans. 1860, p. 566.

‡ Ibid. 1856, p. 558, and pl. xxxi. figs. 9 & 10.

§ Ibid. 1860, p. 553.

|| Ibid. p. 554, plate xx. fig. 3.

sarcode-body, by the agency of which the calcareous substance of this intermediate skeleton seems to have been deposited. The distribution of this canal-system, although often well displayed in transparent sections, is most beautifully shown (as in *Polystomella* *) by the siliceous *casts* which are left after the solution of the shell, these casts being the exact models of the extensions of the sarcode-body that originally occupied its passages.

In those portions of the organism in which the chambers, instead of being regularly arranged in floors, are piled together in an “acer-vuline” manner, there is little trace either of “intermediate skeleton” or of “canal-system”; but the characteristic structure of their proper walls is still unmistakeably exhibited.

Whilst, therefore, I most fully accord with Dr. Dawson in referring the *Eozoon Canadense*, notwithstanding its massive dimensions and its zoophytic mode of growth, to the group of FORAMINIFERA, I am led to regard its immediate affinity as being rather with the *Nummuline* than with the *Rotaline* series—that affinity being marked by the structure of the proper wall of the chambers, which, as I have elsewhere endeavoured to show †, is a character of primary importance in this group, the plan of growth and the mode of communication of the chambers being of secondary value, and the disposition of the “intermediate skeleton” and its “canal-system” being of yet lower account.

I cannot refrain from stopping to draw your attention to the fact that the organic structure and the zoological affinities of this body, which was at first supposed to be a product of purely physical operations, are thus determinable by the microscopic examination of an area no larger than a pin-hole—and that we are thus enabled to predicate the nature of the living action by which it was produced, at a geological epoch whose remoteness in *time* carries us even beyond the range of the imagination, with no less certainty than the astronomer can now, by the aid of “spectrum analysis,” determine the chemical and physical constitution of bodies whose remoteness in *space* alike transcends our power to conceive.

The only objections which are likely to be raised by palæontologists to such a determination of the nature of *Eozoon*, would be suggested by its zoophytic mode of growth, and by its gigantic size. The first objection, however, is readily disposed of, since I have elsewhere shown ‡ that a minute organism long ranked as zoophytic, and described by Lamarek under the designation *Millepora rubra*, is really but an aberrant form of the *Rotaline* family of FORAMINIFERA, its peculiarity consisting only in the mode of increase of its body, every segment of which has the characteristic structure of the *Rotalinæ*; and thus, so far from presenting a difficulty, the zoophytic character of *Eozoon* leads us to assign it a place in the *Nummuline* series exactly corresponding to that of *Polytrema* in the *Rotaline*. And the objection arising from the size and massiveness of *Eozoon* loses all its force when we bear in mind that the increase of FORAMINIFERA

* Phil. Trans. 1860, plate xviii. fig. 12.

† Introduction to the Study of the Foraminifera, chap. iii.

‡ Ibid. p. 235.

generally takes place by gemmation, and that the size which any individual may attain mainly depends (as in the Vegetable kingdom) upon the number of segments which bud *continuously* from the original stock, instead of detaching themselves to form independent organisms; so that there is no essential difference, save that of continuity, between the largest mass of *Eozoon* and an equal mass made up of a multitude of *Nummulites*. Moreover there is other evidence that very early in the Palæozoic age the Foraminiferous type attained a development to which we have nothing comparable at any later epoch; for it has been shown by Mr. J. W. Salter * that the structure of the supposed coral of the Silurian series to which the name *Receptaculites* has been given, so closely corresponds with that which I have demonstrated in certain forms of the *Orbitolite* type †, as to leave no doubt of their intimate relationship, although the disks of *Receptaculites* sometimes attain a diameter of 12 inches, whilst that of the largest *Orbitolite* I have seen does not reach $\frac{8}{10}$ ths of an inch. And it is further remarkable in this instance, that the gigantic size attained by *Receptaculites* proceeds less from an extraordinary multiplication of segments than from such an enormous development of the individual segments as naturally to suggest grave doubts of the character of this fossil, until the exactness of its structural conformity to its comparatively minute recent representative had been worked out.

In a private communication to myself, Dr. Dawson has expressed the belief that *Stromatopora* and several other reputed corals of the Palæozoic series will prove in reality to be gigantic Zoophytic Rhizopods, like *Eozoon* and *Receptaculites*; and I have little doubt that further inquiry will justify this anticipation. Should it prove correct, our ideas of the importance of the Rhizopod type in the earlier periods of geological history will undergo a vast extension; and many questions will arise in regard to its relations to those higher types which it would seem to have anticipated.

In the present state of our knowledge, however, or rather of our ignorance, I think it better to leave all such questions undiscussed, limiting myself to the special object of this communication—the application of my former Researches into the Minute Structure of the Foraminifera, to the determination of the nature and affinities of the oldest type of Organic Life yet known to the geologist.

Jan. 19, 1865.—Sir Henry Holland, Bart., Vice-President, in the Chair.

“Note on a New Object-glass for the Microscope, of higher magnifying power than any one hitherto made. By Lionel S. Beale, M.B., F.R.S., &c.

I desire to record the completion of a new objective, with a magnifying power double that of the twenty-fifth. This glass is a fiftieth, and magnifies nearly three thousand diameters with the low eyepiece. Messrs. Powell and Lealand, the makers, to whom science

* Canadian Organic Remains. Decade i.

† Phil. Trans. 1855.

is indebted for this the highest power yet made, produced a sixteenth in the year 1840, and a twenty-sixth in 1860.

The fiftieth defines even better than the twenty-fifth, which is now made instead of the twenty-sixth. Plenty of light for illuminating the objects to be examined is obtained by the use of a condenser provided with a thin cap, having an opening not more than the $\frac{1}{30}$ th of an inch in diameter. The preparation may be covered with the thinnest glass made by Messrs. Chance, of Birmingham, or with mica, and there is plenty of room for focusing to the lower surface of thin specimens, which can alone be examined by high powers as transparent objects. I beg to draw attention to these very high powers at this time more particularly, because the facts recently urged in favour of the doctrine of spontaneous generation lately revived may be studied with great advantage. Not only are particles, too small to be discerned by a sixteenth, well seen by a twenty-fifth or a fiftieth, but particles too transparent to be observed by the twenty-fifth are distinctly demonstrated by the fiftieth. I feel sure that the further careful study, by the aid of these high powers, of the development and increase of some of the lowest organisms, and the movements which have been seen to occur in connexion with certain forms of living matter (*Amœba*, white blood-corpuscle, young epithelial cells, &c.), will lead to most valuable results bearing upon the much debated question of *vital actions*.

Another very great advantage resulting from the use of the highest powers occurs in minute investigations upon delicate structures which occupy different planes, as is the case in many nervous organs. In studying the distribution of the nerves in some of the peripheral organs of vertebrate animals, very fine fibres can be followed as they lie upon different planes.

The most delicate constituent nerve-fibres of the plexus in the summit of the papillæ of the frog's tongue ("New Observations upon the Minute Anatomy of the Papillæ of the Frog's Tongue," Phil. Trans. for 1864), can be readily traced by the aid of this power. The finest nerve-fibres thus rendered visible are so thin, that in a drawing they would be represented by fine single lines. Near the summit of the papilla there is a very intricate interlacement of nerve-fibres, which, although scarcely brought out by the twenty-fifth, is very clearly demonstrated by this power. In this object the definition of the fibres, as they ramify in various planes one behind another, is remarkable; and the flat appearance of the specimen as seen by the twenty-fifth, gives place to that of considerable depth of tissue and perspective. The finest nerve-fibres ramifying in the cornea and in certain forms of connective tissue are beautifully brought out by this power, and their relation to the delicate processes from the connective-tissue corpuscles can be more satisfactorily demonstrated than with the twenty-fifth. The advantage of the fiftieth in such investigations seems mainly due to its remarkable power of penetration. The angular aperture of this glass is 150° . Many twelfths have been made with a higher angular aperture, amounting to 170° .

ZOOLOGICAL SOCIETY.

May 24, 1864.—Prof. Huxley, F.R.S., V.P., in the Chair.

ON UROCYCLUS, A NEW GENUS OF TERRESTRIAL GASTEROPODOUS MOLLUSCA FROM AFRICA. BY DR. J. E. GRAY, F.R.S., ETC.

Dr. John Kirk has kindly sent to the British Museum, with some other Mollusca in spirits, a specimen of a Slug from the Zambesi.

Naked Terrestrial Mollusca seem rare in that country, for Dr. Kirk says it is the only species of Slug that he observed during his journey: he thinks that the country is probably too dry for them. It was found on some floating weed near the mouth of the river Zambesi. It was not uncommon. This Slug forms a new genus, which may be thus named and described:—

UROCYCLUS.

Body elongate, attached its whole length to the upper surface of the foot. Mantle shield-like, uniformly granular; a small and round deep pit in the middle of the hinder margin. Shell —? Subcaudal gland very large, deep, circular, surrounded by a broad transversely grooved edge. The respiratory aperture on the middle of the right side of the mantle; orifice of generation at the base of the right tentacles. Tentacles four, retractile; lower small.

This genus is exactly like a *Limax* or an *Arion* in external form; but is immediately to be distinguished from either of them by the large size of the deep glandular pit, which is situated on the upper surface of the tip of the tail, and is surrounded by a broad, smooth, raised edge, marked with numerous transverse grooves.

The genus *Milax* is said to have two small pores near the hinder edge of the mantle, which may be analogous to the single pores in the mantle of this genus. The genus *Milax* is certainly destitute of any subcaudal gland or pore, and is referred to the family Limacidae; while the genus here described is peculiar for the large size and general development of the subcaudal pore.

In the pores on the hinder edge of the mantle it may be allied to the *Limax noctilucus* of D'Orbigny and the *Phosphorax noctilucus* of Webb and Berthelot, of Teneriffe; but this animal is so very imperfectly described and badly figured that it is not easy to understand it. Férussac, in the 'Bulletin d. Sci. Nat.' 1821, x. 300, in which it is first noticed under the name of *Limax noctilucus*, only observes, "it is furnished with an aperture in the mantle similar to that in *Arion extraneus*, from which escapes a phosphorescent matter." Now *Arion extraneus* is evidently a *Drusia*; and the hole in the mantle is the space left between the reflexed edges of that organ, exhibiting part of the shell. The figure given by D'Orbigny, in Férussac's 'Mollusca,' p. 76, t. 2. f. 8, exhibits the body contracted, and the hinder part produced into a marginal disk, which is said to be lucid green and phosphorescent in the dark. The tail is described as rounded, and no mention is made of any subcaudal gland of any kind; so that it can scarcely be the genus here described; for the large,

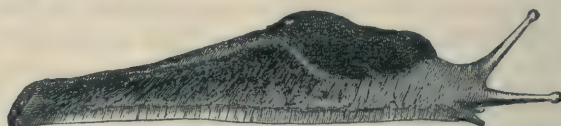
deep subcaudal circular pit, with its large, thick, prominent rim, could not have been overlooked on the most casual examination.

I have not considered it right to cut into the single specimen which we possess of this interesting genus, either to examine the consistence or form of the shell, or to describe the form, structure, and disposition of the teeth—all most important particulars, which I hope the receipt of other specimens will enable me before long to supply.

The pore near the hinder margin of the shield is deep and lined with membrane, which is swollen up and bladder-like at the base in the specimen in spirits, not showing any indication of a shell; and therefore it cannot be (as has been suggested by one zoologist, to whom I had showed the specimen) compared to the open space which is left on the upper surface of the shell by the edge of the mantle being only partially reflected over its outer surface, as in the genera *Drusia*, *Girasia*, *Mærialla*, and *Parmacellus* in the Arionidæ, and *Peltella* in the Limacidæ. It is probably more properly to be compared with the luminous gland which is said to be found, but so imperfectly and differently described as existing in the genus *Phosphorax*.

The mantle is rather produced and free in front and on the front part of the sides, but does not appear to be so free as in the European species of the genus *Limax*.

UROCYCLUS KIRKII.



Pale brown, with minute square black spots on the sides, with a black streak on each side of the back; middle of the back with two darker brown streaks. The sides of the body with diverging sunken lines. The margin of the foot with a series of small black specks.

Hab. Central Africa.

June 28, 1864.—Dr. J. E. Gray, F.R.S., in the Chair.

ON A NEW GENUS OF PEDICULATE FISH FROM THE SEA OF MADEIRA. BY DR. ALBERT GÜNTHER, F.Z.S.

Mr. J. Y. Johnson discovered during his last sojourn in Madeira, on the 24th December 1863, a fish which proves to be the type of a new genus, not only on account of its extraordinary form, but also on account of the absence of ventral fins. In the latter respect it agrees with *Ceratias* from the coast of Greenland, from which, however, it differs in its dentition.

It must be extremely rare, as the specimen entrusted to me by Mr. Johnson for description, and presented by him to the British Museum, is the only one which has ever come to the knowledge of naturalists. Neither the Rev. R. T. Lowe nor Mr. Johnson had heard of its existence, nor did the fishermen recognize it. It is evidently a deep-sea fish, inhabiting the same horizontal marine zone

as *Saccopharynx* and *Alepidosaurus*. When brought to Mr. Johnson, the belly was much distended, and contained, rolled up spirally into a ball, a Scopeline fish, which measured $7\frac{1}{2}$ inches in length, and 1 inch in depth. Nevertheless it was tempted to take a bait.

MELANOCETUS.

Head and body compressed, head very large, body small, abdominal cavity forming a sac suspended from the trunk. Cleft of the mouth exceedingly wide, vertical. Teeth of the jaws and palate long, pointed, unequal in size. Skin smooth. The spinous dorsal is reduced to a single filament placed on the head. The soft dorsal and anal short. Ventrals none. Slit of the gill-openings of moderate width, below the pectoral.

MELANOCETUS JOHNSONII.

D. 1|14. C. 8. A. 4. P. 18.

This singular fish is distinguished by a greater disproportion of the various parts of its body than is found in the other genera of the family to which it belongs. The head is of a tetrahedral form, and is the most extensive part of the whole animal. The gape is enormous; and although the lower jaw is vertical when the mouth is closed, it can be moved downwards at more than a right angle. The lateral extensibility of the mouth is not less than the vertical; so that the prey which can be received within the cavity of the mouth actually may exceed the size of the fish itself. This enormous head is followed by a very small trunk and tail, the length of both being less than the depth of the head. As the trunk would not offer sufficient room for an abdominal cavity corresponding in size to the prey swallowed, this cavity is suspended as a large sac from the lower part of the body, and floats in the water. The upper and lower jaws are armed with a series of teeth which are very unequal in length, some being very long, others small; all are very slender, and can be depressed towards the inside of the mouth: this peculiarity of the teeth may be observed in the *Lophius*, in the Pike, and numerous other rapacious fish with long slender teeth. The vomer is armed with a transverse series of single teeth, and extends across the whole width of the roof of the mouth; the palatine and pterygoid teeth are situated at some distance behind the vomer, and form two bundles irregular in form. The pharynx and œsophagus are, as might be expected, very wide. The eye is situated high up on the side of the head; it is very small, and covered by, but appearing through, the skin. There are no nasal openings. The opercular pieces are reduced to styliform rudiments; there are five branchiostegals. Only the three inner branchial arches bear short branchial lamellæ, which are disposed in a double series on the two middle ones, and in a single one on the innermost arch. The gill-opening itself is a slit of moderate width, below and behind the pectoral fin. The upper surface of the head is concave, and in the middle of its anterior portion there is situated the single filament to which the anterior dorsal

fin is reduced ; this filament is more than half as high as the head, and dilated into a small lamella at its extremity. The second dorsal fin occupies the back of the tail, and is composed of fourteen simple rays, none of which are as high as the fin is long. The caudal fin is quite free from the dorsal and anal, and composed of eight very soft rays, which are bifid at the end, and form a convex posterior margin. Anal fin very short, composed of four rays only, which are opposed to the posterior dorsal rays. The base of the pectoral fin is fleshy and enveloped in skin, as in other *Pediculati*. It is composed of eighteen simple and feeble rays. Ventral fins none. Vent situated immediately behind the abdominal sac. The whole fish, even the inside of the mouth, of the abdominal sac, and of the stomach, is of a uniform deep black.

Total length (mouth closed) $3\frac{8}{10}$ inches ; length of intermaxillary and of mandible $1\frac{4}{10}$ inch.

Nov. 8, 1864.—Prof. Huxley, F.R.S., V.P., in the Chair.

NOTE ON THE CLAWED TOADS (*DACTYLETHRA*) OF AFRICA.

BY DR. J. E. GRAY, F.R.S., ETC.

There has long been known a Toad that has long slender fingers to its fore feet, like the *Pipæ*, and very large webbed hinder feet, some of the toes of which are armed with very distinct horny black claws—a peculiarity of structure that is quite an exception amongst the Batrachian animals.

The specimen first observed was brought from South Africa : it was described and figured by Cuvier, in the second edition of the 'Règne Animal' (vol. ii. p. 107, t. 7. f. 3), under the name of *Dactylethra*. This author states that the animal had been before partially known ; for it is figured, but without its claws, in the 'Planches Enluminées' as the male *Pipa*, I suppose on account of the form of the feet. Daudin described it under the name of the *Crapaud lisse* (t. 30. f. 1) ; and Merrem, in his Compilations, calls it *Pipa bufonia*. It is now generally known as the *Dactylethra capensis* of Cuvier.

Dr. Peters, when examining a specimen of this animal which he obtained from Mozambique, discovered a very small cylindrical appendage, or beard, situated on the front part of the underside of the orbit ; and described it as a new species, under the name of *Dactylethra Mülleri*, in the 'Monatsber. der Berlin. Acad.' (1844, p. 37).

Dr. Hallowell, having observed the same beard under the eyes of a young specimen which he had obtained from the Gaboon through Dr. H. A. Ford, gives a long description of it, under the name of *Dactylethra Mülleri*, in the 'Proceedings of the Academy of Natural Sciences' for 1857, p. 65.

Dr. Günther, in his excellent 'Catalogue of Batrachia Salientia in the British Museum,' published in 1858, admits the two species, and appears not to have observed the minute beard under the eyes in the specimens from South and West Africa, then in the Museum collection ; but when we received, in 1862, the specimen

from Natal collected by Mr. Ayres, he named it the *D. Mülleri* of Peters.

Professor Auguste Duméril, in his paper on African Reptiles, published in the 'Archives du Muséum,' vol. x. (1861), makes some observations on the distinction of the two species, and figures the head of *D. capensis* and the entire animal of *D. Mülleri*, showing the little beard under the eyes in the latter figure and not in the former. He also makes the head of *D. capensis* more produced and narrowed in front than in his figure of *D. Mülleri*; but I cannot see any such difference between the heads of the Cape and Western African specimens in the Museum collection.

I may observe that if these naturalists had examined specimens from South Africa, either near the Cape or even so far north as Natal, they would have found the same beard in the true *Dactylethra capensis*, showing that this beard, at least, is a character of the genus, and not a peculiarity of the Mozambique or West African specimens.

In several of the specimens the beard under the eyes, at least when it is preserved in spirits, varies in size on the two sides of the animal; and in one specimen it is scarcely visible on one side, and well developed on the other.

Dr. Peters also gives as a character of his *D. Mülleri*, that it has a spur at the base of the first toe; and Dr. Hallowell observes that the specimen he had from Gaboon "differs from the *Dactylethra* of the Cape, more especially in the presence of a sharp-pointed spur projecting from the cuneiform bone, which is not observed in *Dactylethra capensis*."

Dr. Günther, in his 'Catalogue' (p. 2), also uses this spur as part of the specific character. He says—

D. laevis. "Tarsus and metatarsus without any tubercle or spur."

D. Mülleri. "A spur at the base of the first toe."

Professor Auguste Duméril, in the paper before referred to, figures the feet of *D. capensis* (t. 18. f. 6, 6a) for the purpose of comparing them with the feet of the other figure (of *D. Mülleri*), and observes, "On peut saisir ainsi des dissemblances fort évidentes des deux espèces" (p. 232), showing the spur very distinct in the latter, and not visible in the former—in fact, making the figure agree with the characters assigned, as in the case of the beard under the eyes, rather than as they are in nature.

On examining the specimens from the Cape of Good Hope (collected by Sir Andrew Smith and Mr. Hunter), from West Africa (collected by Mr. Fraser and Mr. Welwitsch), and from Natal (collected by the Rev. H. Callaway and Mr. T. Ayres), I find they all have exactly the same kind of spur, which is least distinctly marked in the latter specimen, from Natal, called *D. Mülleri* by Dr. Günther; but the distinctness of the spur appears to depend on the whole foot being larger and more plump, and it is more distinctly developed or prominent in the smaller than in the larger specimens.

The black horny claws which cover the last joint of the three outer toes and the spur of the hind foot are deciduous in spirits.

Hence the spur may have been overlooked in specimens which have been long in spirits; and the distinctness of the spur greatly depends on the presence or absence of this claw. These black claws are to be seen on the youngest specimens as soon as the toes are developed.

The skin is scattered with small white lines dispersed in a symmetrical manner, which, when examined by a magnifier of rather high power, display linear series of close minute perforations or glandular openings. Dr. Hallowell seems to have observed some of these; for he mentions "the semilunar rows of longitudinal glands on the throat;" but he does not seem to have seen that they are symmetrically distributed over nearly the whole of the body, and especially on the head, the back, and the sides, as well as the throat. He specially observes that the skin is smooth, and that there is no lateral line visible.

Professor Auguste Duméril does not take any notice of them in his short observations; but in his figure of *D. Müller*i (t. 18. f. 3) he represents the double series of them that surrounds the back like a double series of short prominences or tubercles, very unlike the sunken line of pores which they are—indeed so unlike that I should not have understood what they were intended to represent on this smooth-skinned Toad, had I not previously observed the glands, and if they were not placed exactly where the double line of pores is situated, and where there are no such prominences on the animal as his figure seems to represent.

I will now proceed to notice the distribution of the more important of these white glandular lines. There are two horizontal lines, slightly separated in the middle, at the end of the nose, under the



nostril; a line between the eye and the nostril; and a series of oblique lines across the swollen band which surrounds the eye on the

edge of the orbit ; two rows of glands on the back of the neck, placed rather obliquely to each other, and some scattered ones on the outer side of them ; two series of short lines from the middle of the temples, continued over the shoulder, along the sides, over the base of the thigh, to the upper surface of the vent ; the upper line in these series is longitudinal, and the lower ones larger and transverse to the direction of the upper line. On the under parts there is a lunate series of arched linear glands across the throat and on each side of the body, commencing by an arched line round the back of the axilla, continued in a curved line, with the convex side of the curve downwards, along the side of the belly, and thence to the groin.

The disposition of these glands will appear to be of some importance in a zoological point of view when one studies the character of the genus *Silurana*. These glands, especially those on the underside of the body, are much more distinct in some specimens than they are in others ; but I suspect this depends on the season when the specimen has been captured, and especially on the state and manner in which the specimen has been preserved.

The specimens in spirit rather vary in colour ; but this may depend on the length of time that they have been in spirit, on the exposure to which they have been submitted, and on the strength of the spirit in which they were originally preserved.

The specimens of an adult male and female from West Africa, presented by Mr. Welwitsch, are of a uniform olive-brown above and yellowish below, marbled with very distinct, unequal-sized, subsymmetrically distributed olive spots.

The specimen from the Cape, presented by Sir Andrew Smith, which is in a rather soft state, is olive obscurely spotted above, pale whitish grey beneath, obscurely marked with small darker spots.

The adult specimen from Natal, collected by Mr. Ayres, and the smaller specimen from West Africa are of a uniform olive-brown above and pale grey-brown beneath, without any indication of spots.

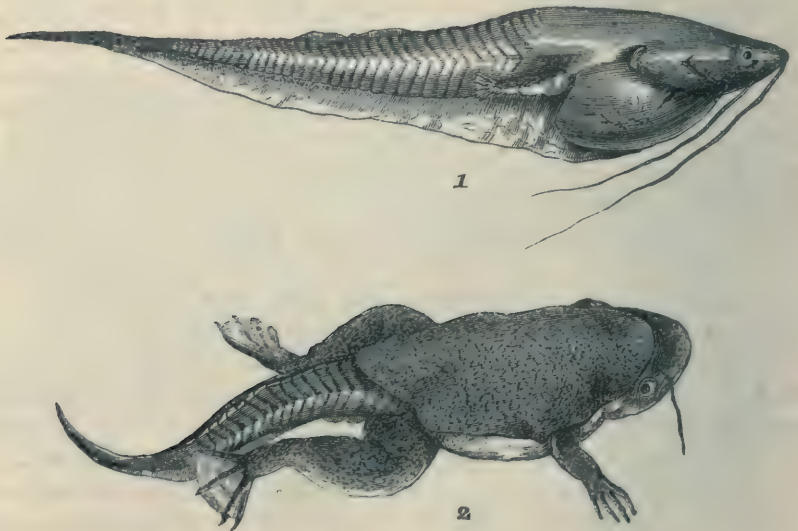
Mr. R. B. N. Walker (to whom we are indebted for the best account of the habits of the Gorilla, and who has brought to England some most interesting animals from Western Africa) has lately been living at Lagos, where he observed some Tadpoles that were developed in abundance in a pond adjoining his residence. He put some of these in spirits, and gave them to the Free Museum at Liverpool. Mr. Moore having kindly sent me some of these specimens for examination, I was soon convinced that they had not before been observed, and therefore sent a short notice of them to the 'Annals and Magazine of Natural History' for September 1864, and named them, from their resemblance to the genus *Silurus*, *Silurana tropicalis*.

Some naturalists having expressed a doubt if the animals sent home by Mr. Walker were not the young of the common *Dactylethra* (an opinion that I entertained myself when I first saw them, and until I had compared them with the papers on the subject), I have been induced to reconsider the question, and to study the genus. This study has led me to the conclusion that the two geographic species of *Dactylethra* are but one, which is spread over the whole of South

and Western Africa ; and also to retain the opinion that I have published, that the specimens brought by Mr. Walker from Lagos are probably of a distinct form. I will not take on myself to deny the possibility of their being the larva of *Dactylethra*, as the larva of that genus and the adult form of *Silurana* are unknown ; but even if it is proved hereafter that they are only the larva of *Dactylethra*, I think that it is better for the present to keep them separate, until the change from one state to the other has been observed and recorded ; at all events, the description and observation of the larva is an important addition to the history of the genus.

It would be a remarkable change, if the large beard that is placed at the angle of the mouth in one genus should turn into the minute beard on the lower edge of the orbit, far above and in front of the angle of the mouth, in the other ; yet I am assured by an experienced herpetologist that he believes this change does take place, and that it is only consistent with what is to be observed in the transformation of other Batrachians. No such changes have occurred to me. There is no doubt that the beard at the angle of the mouth is much longer and more slender in the young larva than it is in the oldest specimen we yet possess of the genus *Silurana*. But while the beard diminishes in length, it increases considerably in thickness, showing no inclination to disappear, and does not at all alter its place in any of the specimens I have observed either in the British Museum or at Liverpool.

The least-developed fish-formed specimen (fig. 1) is about $2\frac{1}{2}$ inches long, and has only the hinder pair of legs developed. The legs are



short and weak ; and the toes are short and of nearly equal length, but with the three black claws well developed. The head is depressed, very broad, and flat above, and shelving to near the back

behind. The mouth is small, with a very long slender beard on the upper lip, at the angle of the mouth. The eye is on the keel on the side of the head, considerably behind the beard, placed so as to be visible from the upper and lower surface. The body is swollen; the tail compressed; the inferior fin commences in the middle of the belly, and is extended to the end of the tail.

There is a second fish-formed specimen, not more than 2 inches long and much more slender, which also has the front limbs developed, from the upper part of the sides; these limbs are weak, and the toes are short and equal. The hinder limbs are rather more developed, their toes rather more unequal; and the fin on the under part of the body and tail is also broad and more membranaceous. The mouth, beard, and eyes are exactly as in the former specimen.

The other two specimens (fig. 2) have assumed the form of the genus *Dactylethra*, having both the fore and hind limbs well developed, the eye on the side of the head only visible from the upper surface; but they have a well-developed tail attached to their bodies, with a very narrow, thin inferior membrane. The nose is blunt, rounded at the sides. The mouth small, the beard well developed at the angles. The eyes are far behind the angle of the mouth, and without any appearance of a small beard on the under part of the orbits. These specimens have a very distinct spur, covered with a black claw, at the inner side of the base of the hind foot.

I am willing to admit that there are some facts which might induce one to believe that these animals may prove to be the larva of *Dactylethra*; and, as truth is my only object, I think it right to state them, though they may only be similarities that are common to two genera of the same family.

1. There is a small, white, round, prominent dot on the side of the nose in front, nearly on a level with the lower part of the orbit, which appears as if it might develope itself into the orbital beard of *Dactylethra*; and I think this much more likely to be the case, than that the beard of the angle of the mouth should become the suborbital beard.

2. There are the same double rows of glands which I have described as found in *Dactylethra*; but in these young animals they have a very peculiar appearance. On the forehead, rather in front of the eyes, there is a transverse groove, which is continued over the eyes, the base of the fore legs, along the side to the groin, and then bends up again, and becomes united to a similar groove on the upper surface of the body, which circumscribes an oval well-marked disk or shield that covers the back. The two rows of glands above described are placed on the margin of this shield. The glands are visible in the adult *Dactylethra*, but the disk is not distinguishable. The disk is not distinguishable, except as a slight thickness on the back of the base of the tail, in the two fish-shaped larvæ. This shield is peculiar; it would almost seem to show that there is a certain affinity, or analogy, between the Toads and the Chelonians, or rather the freshwater Emydians.

DACTYLETHRIDÆ.

Head depressed; upper jaw toothed; tongue none; eyes with an inferior lid; orbits swollen, marked with transverse oblique white lines of minute pores. The Eustachian tubes united into one pharyngeal orifice. Skin smooth. Head and body with white lines of minute pores, symmetrically disposed. The back with a more or less distinct dorsal shield, commencing on the temples, and continued to the upper part of the base of the tail, marked by two series of short white lines of minute pores (the outer transverse and the inner longitudinal), and a more or less raised edge. The fore feet with four subequal tapering free toes. The hind feet with five elongated, rather unequal toes broadly webbed to the tips, the three outer toes and the spur on the outer side of the ankle furnished with black conical horny claws.

1. DACTYLETHRA.

The dorsal shield indistinct, only marked by the double series of glands. Mouth large, not bearded. Orbit with a small beard on the under edge.

D. CAPENSIS, Cuvier. *D. lævis*, Günther. *D. Mülleri*, Peters, Hallowell, Duméril.

Hab. South and South-eastern Africa.

2. SILURANA.

The dorsal shield very distinct, with a raised edge, and separated by a groove on the forehead. Mouth small, with an elongated beard on each side at the angle of the gape. Orbit without any beard. The larva fish-like; head flat, broad, truncated; mouth small, two-bearded; eyes in the keel of the side, shown above and below; body swollen; tail elongate, compressed; the belly and underside of the tail with a broad, membranaceous fin continued to the end of the tail.

S. TROPICALIS, Gray, Ann. & Mag. N. H. ser. 3, vol. xiv. p. 316.

Hab. Lagos (*R. B. N. Walker, Esq.*).

REVISION OF THE GENERA AND SPECIES OF CHAMÆLEONIDÆ,
WITH THE DESCRIPTION OF SOME NEW SPECIES. BY DR.
J. E. GRAY, F.R.S., F.L.S., ETC.

The Chameleons form one of the most natural families of Lizards, as well as one of the most clearly defined. The distinction of the species from one another, as is almost always the case in a natural group, is difficult, and requires careful study and consideration. The species in general are well marked when the characters are eliminated; but there are a few species, as *Chamæleon vulgaris* and *C. senegalensis*, which have a broad geographical distribution, that offer several variations such as, if the differences did not appear gradually

to pass into each other, might induce one to believe that they were specific; but they can hardly be even considered as local varieties, for the same variation seems to occur in specimens from different localities often situated far apart.

There is considerable difference in the sexes, especially of the horned species which, I believe, was first established in my 'Monograph;' but this difference does not appear to be common to all the species of the Horned Chameleons; for while the females of *C. Owenii*, *C. bifidus*, and *C. Parsonii* are hornless, the expansions on the sides of the nose of *C. pardalis*, which are analogous to the horn in *C. bifidus*, are as much expanded in the adult female as in the males of that species.

The female specimens are much more common in museums than males; they are perhaps more easily caught when they come to the ground to deposit their eggs: and this appears more probable from the fact that females containing eggs are often to be found among those collected. In some cases, even where there is a series of specimens, they are all females; at least I have not, from the external appearance, been able to discover a male of *C. senegalensis* or *C. dilepis*.

Dr. Hallowell (Journ. Acad. Nat. Sc. Philad. vii. 99) thought at one time that the occipital lobes were peculiar to the females; I also was once inclined to believe this might be the case, before I had seen his remark, from observing that all our specimens of *C. dilepis* appear to be females; but I had the same difficulty in finding any males of *C. senegalensis* or other allied species; and M. A. Dumeril specially observes that "the cutaneous prolongation is not a character only of the female *C. dilepis*" (Arch. du Mus. x. 174).

There is considerable variation in the distinctness and height of the occipital crest in the specimens of *C. vulgaris* and in some other species. This often arises from the animals having been kept in confinement without (or with only a very limited supply of) food, until the muscles have shrunk. This should make one careful in using the height of the crest as a character, more especially as many of the specimens in museums have been kept alive in confinement either in the country which they naturally inhabit or in some other, as collectors like to have them alive as pets.

Yet the well-fed and fresh-caught specimens seem to vary considerably in this particular; for example, specimens of *C. vulgaris* from India, as a rule, seem to have the occipital crest higher and more arched than African specimens; but still there are in the Museum collection some African specimens which have quite as high crests.

Little attention seems to have been paid to the coloration of the species, probably because the animal greatly changes its colour during life; and specimens in spirits of some species, such as of *C. vulgaris*, offer many variations, from bright yellow to dark lead-grey. Yet in some species the distribution of the colours, at least in specimens in spirits, seems to form permanent specific marks, as, for example, the lines or white spots or white bands on the sides of several species.

The number of species has gradually increased. In my Mono-

graph, published in the 'Catalogue of Lizards in the British Museum,' printed in 1845, I described eighteen species; the present revision contains thirty, distributed into fourteen genera.

Since the above Monograph, Dr. Hallowell has described three or four species from West Africa, in the 'Journal' and 'Proceedings' of the Academy of Natural Sciences of Philadelphia; but unfortunately I have not been able to make any of the specimens in the Museum collection agree with his descriptions. M. A. Duméril, in the 'Archives du Muséum,' has described and figured two new species, and he has given figures of the heads of fifteen other species. I have referred to these figures, as they elucidate several species described in my Monograph which had not before been figured. Unfortunately the figures are not as accurate as they might be; and one, that of *C. cucullatus*, is either absolutely erroneous or is from a Chameleon that differs very considerably in the proportion of the head, and in having a dentated crest on the chin, from the species to which M. A. Duméril has referred it, which was originally described by me from specimens in the British Museum collection—the account in the 'Érpetologie Générale' having been copied from my description.

Dr. Andrew Smith, in the fifth number of the 'South-African Quarterly Journal,' published at the Cape of Good Hope in October 1831, describes two new species, viz. *C. namaquensis* and *C. tænia-bronchus*; and in the Appendix to his 'Zoology of South Africa,' 1849, he describes a third, under the name of *C. gutturalis*. I have not been able to identify the two latter.

Dr. Fitzinger, in his 'Systema Reptilium,' published at Vienna in 1843, is the only author, as far as I know, who has attempted to divide the Chameleons into genera. He separates the family into two genera—*Chamæleon*, with homogeneous, and *Bradypodium* with heterogeneous scales. The rest of the lengthened characters which he gives for the genera are only transcripts of one another. He divides the first genus into three sections, viz. *Chamæleon*, *Triceras*, and *Furcifer*. The genera and the sections consist of species which have very little affinity, and appear to be very incongruously associated together: for example, *Furcifer* consists of *C. bifurcus*, *C. Parsonii*, and *C. Brookesii*; and *Bradypodium* of *C. pardalis*, *C. verrucosus*, *C. pumilus*, and *C. cucullatus*. The species are not characterized, except by the synonyms appended. It appears that he divides *C. vulgaris* into four, and *C. senegalensis* into two species.

The species have hitherto, except in the instance of Fitzinger above cited, all been referred to a single genus, in which they have been generally arranged in an artificial manner, merely to facilitate the finding of their names.

The species throw themselves into groups agreeing in natural characters: these groups are quite as distinct as the groups in the other families, which are regarded as genera; I have therefore so regarded them. If a comparison of genera of different families is to be established, and their affinities to each other studied, the genera in the different families should be formed on the same plan.

The Chameleons are essentially confined to Africa and the islands near to that continent. Thus, as far as we at present know, the following species, *Chamæleon calyptratus*, *C. verrucosus*, *C. balteatus*, *Apola lateralis*, *Calumma cucullata*, *Crassonota nasuta*, *Sauroceras rhinocerotum*, *Dicranosaura bifurca*, and *D. Parsonii*, are confined to Madagascar; *Cyneosaura pardalis* to the Isle of Bourbon; *Lophosaura tigris* to the Seychelles; *C. Burchelli*, *Pterosauria cristata*, and *Triceras Owenii* to Fernando Po and perhaps Old Calabar; *C. gracilis* to West Africa—Liberia; *C. Petersii* to Mozambique; *Ensirostris Melleri* to Eastern Africa; *C. auratus* to Arabia; *C. granulatus*, *Brookesia superciliaris*, and *C. senegalensis* to W. Africa; *C. lævigatus* to Central Africa; *C. affinis* to Abyssinia; *Phumanola namaquensis* to South-east Africa; *Lophosaura pumila* and *L. ventralis* to South Africa. *C. dilepis* is common to the west and south-east coast of Africa; while *C. vulgaris* is distributed over North and South Africa, Asia Minor, India, and Singapore.

Fam. CHAMÆLEONIDÆ, Gray, Cat. Lizards Brit. Mus. .264 (1845).

CHAMÆLEON, Gronovius, Fitz.

Synopsis of the Genera.

A. *The nose and orbit simple, not horned.*

1. CHAMÆLEON. Back and belly with a series of compressed elongated scales.
2. APOLA. Back-edge broad, with two series of minute scales; belly dentated.
3. PTEROSAURUS. Back and tail with a high fin, supported by bony rays, smooth-edged; belly dentated.
4. MICROSAURA. Back and chin crested; occiput keeled, compressed; sides smooth, divided into two square disks.
5. PHUMANOLA. Back rounded, with a series of large bony tubercles covered with scales.
6. LOPHOSAURA. Chin with a series of elongated processes covered with scales.
7. CALUMMA. Orbit with large lobes, covered with scales behind; back dentated; belly and chin rounded, not dentated.

B. *Nose simple; orbit angularly produced in front.*

8. BROOKESIA.

C. *Nose and orbit with cylindrical horns, covered with a sheath.*

9. TRICERAS. Horns, one on the nose and one on the front of each orbit.

D. *Nose with one or two bony prominences covered with scales.*

10. CRASSONOTA. Nose compressed in front, with a flexible compressed lobe covered with scales; back with a distant series of slender elongated scales.

11. ENSIROSTRIS. Nose-horn single, bony, central, sharp-edged above ; occiput lobed behind ; back with a lobed, erect fin.
12. SAUROCERAS. Nose-horn single, bony, central, sharp-edged below, grooved above ; occiput simple behind ; back dentate.
13. DICRANOSAURA. Nose-horns two, produced, compressed ; back compressed ; belly and chin rounded.
14. CYNEOSAURA. Nose dilated, and toothed on each side in front ; back, chin, and belly dentate.

A. *Nose of male and female simple, not dilated ; orbit simple.*

1. CHAMÆLEON.

Nose (of both sexes) simple, without any appendages or horns ; the chin simple ; orbit round, simple. The back, chin, and belly with a series of compressed elongated scales, forming a dentated crest.

a. *Occiput produced and acute behind, with raised central keel, with small scales behind the temples.* Calyptrousaura.

1. CHAMÆLEON CALYPTRATUS, A. Dum. Arch. du Mus. vi. t. 21. f. 1.

The occipital ridge very high and large ; scales equal, small.

Hab. Madagascar (*Mus. Paris.*).

I only know this species from the description and figure of M. A. Duméril.

2. CHAMÆLEON VERRUCOSUS, Gray, Cat. B. M. 267 ; Dum. & Bib. Erp. Gén. iii. t. 27. f. 1. B.M.

Bradypodium verrucosum, Fitz. Syst. Rept. 43.

Scales unequal ; sides with several series of larger tubercles.

Hab. Madagascar. Males and females similar.

The series of scales on the belly and chin becomes less distinct in the older specimens.

- b. *Occiput produced and acute behind, with a raised central keel and with a flat space edged with a series of large scales, from the apex to the sides of the temple.* Chamæleon.

3. CHAMÆLEON VULGARIS, Gray, Cat. B.M. 265 ; A. Dum. Arch. du Mus. vi. t. 22. f. 1 (head). B.M.

The occipital crest moderate, upper edge arched ; the side margin with a series of large scales, and more or less elevated ; scales equal.

In spirits, brown, with two more or less interrupted pale longitudinal bands on each side ; eyelids dark-rayed.

Hab. Africa and Asia ; and naturalized in Europe.

Var. *marmoratus*. Forehead very concave ; eyebrows and occipital crest very high. In spirits, pale brown, marbled with irregular black cross marks.

Hab. Dukhun (*Col. Sykes*).

In the British Museum there are specimens from S. Europe (*P. B. Well*) ; N. Africa, Egypt (*J. Burton*), Algiers and Tunis (*Fraser*),

Tripoli (*Ritchie*); S. Africa (*Col. Denham*); Asia Minor, Xanthus (*Fellows*); India, Calcutta (*Hardwicke, Livesay*), Dukhun (*Sykes*), Anamallay Mountains (*Beddome*), Singapore (*Cantor*); Japan (*Zool. Soc.*).

After a most careful comparison, I have not been able to discover any distinction between the African and Asiatic specimens. The Asiatic ones have the bands on the sides less marked; indeed they are generally absent, but in some specimens they are clearly indicated. I was much tempted to separate them on this ground; but this character, and the height of the occipital crest, would not hold out after a rigorous examination and comparison.

|| Fitzinger, in his 'Systema Reptilium,' gives the names of *C. coromandelicus* to the Chameleon of India, *C. africanus* to that from Africa, *C. rimulosus* to that from Egypt, and *C. hispanicus* to that from Spain; but these species, or presumed species, are not characterized.

4. CHAMÆLEON AURATUS.

B.M.

The scales large; dorsal, chin, and ventral crest well developed. The occiput extended and rather pointed behind, covered above with rather convex scales. The dorsal ridge is strongly toothed.

In spirits, pale yellow, with many bright yellow spots, and without any white spots or bands.

Hab. Arabia (*H. Christy*).

There is a second specimen, allied to this Chameleon, in the Museum collection, which differs in the occipital keel being very much lower and flatter; but in other respects they are very much alike. The one with the flatter occipital keel was received from the Zoological Gardens, and was said to have been sent from Mexico.

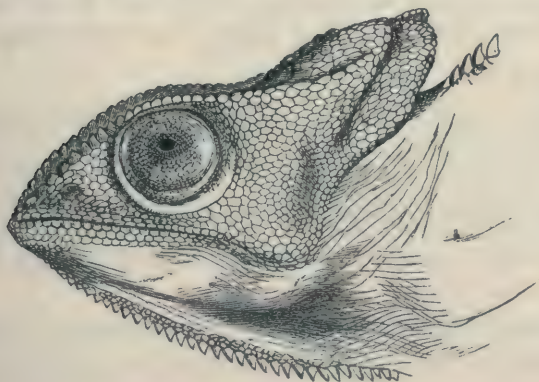
c. *Occiput produced and acute behind, with a distinct central keel, with large hood-like occipital flaps, from apex to side of the temple, covered with flat scales.*

5. CHAMÆLEON PETERSII, n. s.

B.M.

C. dilepis, Peters, MS.

Back compressed, with a series of large compressed scales; fore-



Chamæleon Petersii.

head narrow, covered with flat scales with a strong sharp edge on

each; occiput contracted and short-edged behind, with a well-raised central keel arched on its upper edge; occipital flaps broad, rounded, covered with large, flat, hexagonal scales; scales small, equal; chin and belly dentated, covered with flat scales.

In spirits, dark green, with a white spot behind the temple, and also a white streak from the axilla; forehead, temple, and side of occiput white.

Hab. E. Africa, Mozambique (*MacLeod, Dr. Peters*).

Var. *Kirkii*. The occipital lobes smaller.

B.M.

C. dilepis, Gray, P. Z. S. 1864.

Hab. Eastern Africa (*Dr. Kirk*). A female.

- d. *Occiput produced and acute behind, with a low keel, and two large broad flaps behind, covered with large, irregular, convex shields; scales of body and limbs with larger tubercles.*

6. CHAMÆLEON MONACHUS.

B.M.

Brown (in spirits), dorsal keel and body white-speckled, upper and lower lip at the gape, and ventral crest white; the occipital flaps large, with irregular, unequal, flat shields; the body and limbs with low, convex, larger tubercles.

C. cucullatus, A. Duméril, Arch. du Mus. vi. t. 6. f. 9 (not Gray).

C. Parsonii, Cat. Mus. Zool. Soc. MS.

Hab. Madagascar.

The head of this species is not well figured as that of *C. cucullatus* by M. A. Duméril. It is at once known from that species by the form of the occiput, and the crest on the chin and belly. It is a fine large species. We received it from the Zoological Society in 1855.

- e. *Occiput broad and rounded behind, flat above, with a scarcely raised central line behind.*

† *The sides of the occiput with small granular scales.* Erizia.

* *Chin and belly with a distinct denticulate line of white scales.*

7. CHAMÆLEON SENEGALENSIS, Gray, Cat. B. M. 286; A. Dum. Arch. du Mus. vi. t. 22. f. 7 (fig. bad); Fitz. Syst. Rept. 41. B.M.

? *C. leptopus*, Fitz. Syst. Rept. 41.

Scales large; head broad and rounded behind; occiput covered above with convex scales.

In spirits, brown or purplish.

Hab. West Africa, Senegal (*Earl of Derby*).

8. CHAMÆLEON LÆVIGATUS, Gray, P. Z. S. 1863; Ann. & Mag. N. H. 1863, xii. 248. B.M.

Scales minute; the dorsal crest very indistinct, only visible on the nape; head rhombic behind; occiput covered above with flat thin scales.

Hab. Central Africa, Chartoom (*Petherick*).

Probably only a young specimen of the preceding.

9. CHAMÆLEON GRACILIS, Hallowell, Journ. Acad. N. S. Philad. viii. 324, t. 18 (♀ and eggs); Proc. Ac. N. S. Philad. 1854, 99; A. Dum. Arch. du Mus. x. 173 (a note only). B.M.

C. senegalensis, var., Gray, Cat.

Scales large; head broad and acute behind; occiput covered above with convex scales.

In spirits, olive, with a white spot on the shoulder, or interrupted on the upper part of the back, and with a band of white spots from the axilla.

Hab. W. Africa, Senegal (*A. Gerrard*), Angola, Congo, Cuanga, and Pungo Adongo (*Dr. Welwitsch*), ? Liberia (*Dr. Ford*).

Var. ? *leiocephalus*.

B.M.

C. dilepis, Gray, Cat. Mus.

Scales and colour like the former; the scales on the crown and occiput above flat, smooth, hexagonal.

Hab. W. Africa, Fantee (*Capt. Marryat*), Ashantee (*Mus. Leyden*).

The figure of Dr. Hallowell is a moderately good representation of this species; but the name is not the best, as it is a stouter and stronger species than *C. senegalensis*.

** *Chin without any white dentated ridge of scales; belly dentated.*

10. CHAMÆLEON AFFINIS, Rüppell; Gray, P. Z. S. 1863; Ann. & Mag. N. H. 1863, xii. 248.

C. abyssinicus, Wiegmann, Mus. Berolin.; Fitz. Syst. Rept. 43.

Lead-coloured (in spirits), with two long white spots on the temple behind the eyes, upper part of back with an interrupted broad white band; scales large, subequal.

Hab. Abyssinia, from Mus. Francofurt.

*** *Chin dentated; middle of belly not dentated.*

11. CHAMÆLEON BALTEATUS, A. Dum. Arch. du Mus. vi. 260, t. 21. f. 2; x. 174.

Back dentated; scales subequal, brown; edge of jaws, middle of the belly, and tail, a broad oblique streak from shoulder to groin, and a streak on each side of the belly yellowish; chin slightly dentated; "middle of the belly not dentated" (Arch. Mus. x. 174).

Hab. Madagascar (*Mus. Paris.*). A single specimen. I have not seen this species.

The following species appear to belong to this division:—

12. CHAMÆLEON GRANULOSUS, Hallowell, Proc. Acad. N. S. Philad. 1856, 147.

Grey; belly bluish; scales on the sides unequal, tubercular; four

or five rows of flat quadrangular scales between the dorsal denticulations and the lateral tubercles.

Hab. West Africa (*Mus. Philad.*). A single specimen.

13. CHAMÆLEON BURCHELLI, Hallowell, Proc. Acad. N. S. Philad. 1856, 147.

Greenish, with a lateral yellow stripe; scales of body unequal, tubercular, subrhomboid, interspersed with very small granules; of sides of head, rather large, flattened.

Hab. Fernando Po (*Mus. Philad.*). A single specimen.

†† *Sides of the occiput with a fleshy lobe, covered with scales from the apex of the occiput to the middle of the temple. Dilepis.*

14. CHAMÆLEON DILEPIS, Leach; Gray, Cat. B. M. 266; A. Smith, Zool. S. Africa, App. 3; A. Dum. Arch. du Mus. vi. t. 22. f. 8 (not good). B.M.

C. bilobus, Kuhl; Fitz. Syst. Rept. 41.

Dorsal crest of a single series of short conical scales; scales of body conical, convex; of crown and forehead flat, larger.

In spirits, bluish brown, a short white streak at angle of mouth, and a white band from the axilla along the sides of the belly, and another over the shoulder.

Hab. West Africa (*Richardson*), Gaboon (*Bowdich*), the type specimen described by Dr. Leach; S. Africa, Latakoo (*A. Smith*), Port Natal (*Rev. H. Calloway, Ayres*).

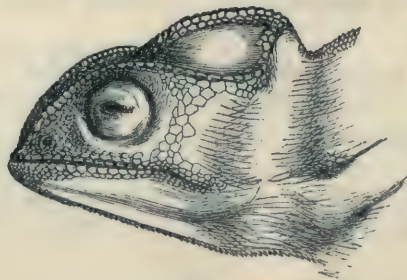
2. APOLA.

Nose of both sexes simple; orbit rounded. Chin and belly dented. Back compressed; upper edge flat, with a series of minute scales on each side. Occiput keeled. Scales granular, equal.

1. APOLA LATERALIS.

B.M.

Chameleo lateralis, Gray, Cat. B. M. 264; A. Dum. Arch. du Mus. vi. t. 22. f. 6 (head).



Apola lateralis.

Pale brown, with a narrow, continued pale streak on the middle of the sides; ventral line white.

Hab. Madagascar.

3. PTEROSAURUS.

Nose and chin simple. Back and tail with a high crest, supported by long bony rays. Belly slightly dentated. Chin and back smooth-edged. Orbit rounded. Occiput much produced, sloping, acute behind, flat above, or rather concave, without any central ridge; hinder sides covered with very small scales. Scales small, with scattered larger ones.

1. PTEROSAURUS CRISTATUS.

B.M.

Chameleo cristatus, Gray, Cat. B. M. 264.

Sides with a series of larger circular scales.

In spirits—red-brown, with numerous large, equal, roundish, white spots.

Hab. Fernando Po; Old Calabar (*Murray*).

One of the Museum specimens has two dark spots in front of the upper part of the nose over the nostrils. Is this a sexual character?

4. MICROSAURA.

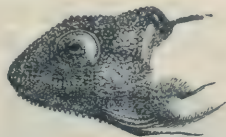
The occiput much narrowed and compressed behind, flat above, with a slightly raised central keel; the side of the occiput with a smooth space, separated from the smooth temple by a central nodulous ridge (as in *Lophosaura*). Back and chin with a crest of small compressed scales. Belly not dentated. Scales of body unequal; of legs equal, flat.

1. MICROSAURA MELANOCEPHALA.

B.M.

White (in spirits), head and shoulders black, fore legs blackish; scales of the body granular, small, convex; with a longitudinal series of large, circular, slightly raised tubercles on the middle of each side, and with a similar series of small tubercles on the sides of the middle of the back; scales of the legs larger than those of the body, flat, equal.

Hab. S. Africa, Port Natal, 1862.



Head of *Microsaura melanocephala*.

5. PHUMANOLA.

Nose and chin simple. Back with a series of large bony tubercles covered with scales. Orbit very prominent, rounded. Occiput triangular, with a central nodulous ridge; small convex scales. Scales uniform, convex. Forehead, crown, and back of chin and belly not toothed. Tail cylindrical, rounded above.

1. PHUMANOLA NAMAQUENSIS.

B.M.

Chamaeleo namaquensis, A. Smith, Zool. Journ. 1831; A. Dum. Arch. du Mus. vi. t. 22. f. 3*.

C. tuberculiferus, Gray, Cat. B. M. 267.

In spirits, dark brown, paler below; sides black-spotted, with a series of irregular-shaped, black-edged, pale spots along the middle; belly with a dark-edged, central, broad longitudinal band.

Hab. S. Africa—Little Namaqua Land, near the mouth of the Gariiep or Orange River (*A. Smith*).

6. LOPHOSAURA.

Nose simple, without appendages. Chin with a series of skinny lobules beneath. Occiput produced, acute behind, keeled above. Back and throat often dentated. Scales unequal. Belly not toothed.

a. *Back compressed, with a continuous series of large compressed scales; scales unequal.* Lophosaura.

1. LOPHOSAURA PUMILA.

B.M.

Chamaeleo pumilus, Gray, Cat. B. M. 269; A. Dum. Arch. du Mus. vi. t. 22. f. 5.

Bradypodium pumilum, Fitz. Syst. Rept. 43.

Scales of body and limbs moderate, unequal, with one or two series of large scales on the sides; sides of occiput and temples covered with flat scales.

In spirits, bluish, with a white streak from the orbit to the shoulder, and from the temples along the sides of the back.

Hab. South Africa; Cape of Good Hope.

Var. *Fordii*. Scales larger, more acute; tubercles on the side of the back large, elongate, keeled; throat-fringe elongate, covered with acute scales; scales of belly small, equal.

Hab. S. Africa, on branches of underwood; from Haslar Hospital.

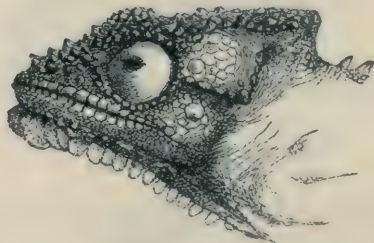
Trup sutchees of the Cape Colonist; that is, "Tread lightly."

2. LOPHOSAURA VENTRALIS.

B.M.

Chamaeleo ventralis, Gray, Cat. B. M. 268.

C. pusillus, var.?, A. Smith, S. A. Zool. App. 2; A. Dum. l. c. 261.



Lophosaura ventralis.

Scales small, with three or four series of large, flat, oval scales, with

convex centres, on the sides, and several series on the sides of the belly, and two series on the sides of the tail.

Hab. S. Africa. Male and female.

b. *The back with a series of distant conical compressed scales; tail and belly not crested.* Archaius.

3. LOPHOSAURA TIGRIS.

B.M.

Chameleo Tigris, Gray, Cat. B. M. 268; A. Dum. Arch. du Mus. vi. t. 22. f. 3.

Scales of temple, occiput, back, and limbs uniform, small, granular.

In spirits, yellow, brown-spotted; spots sometimes confluent, forming short longitudinal lines.

Hab. Seychelles Islands.

Chamæleo gutturalis, A. Smith, Append. Z. S. A. 3.

“Back and tail surmounted with three rows of three-sided tubercles; body and tail covered with small scales and subconic tubercles; sides with two longitudinal rows of large subovate flat plates; chin and throat fringed longitudinally with long, small, thin, narrow and pointed lobes of skin. Length $6\frac{1}{2}$ inches.

“*Hab.* S. Africa.

“Distinguished from *C. pumilus* by the length of the lobes of the guttural fringes, and their being smooth and destitute of granular scales.”

We have no specimen of this genus which has the scaleless lobes of the chin here described.

Chamæleo tæniabronchus, A. Smith, S. Afr. Quart. Journ. 1831, p. 17.

“Yellowish green, with two longitudinal buff stripes along each side, and four or six smooth, oblong, jet-black stripes along the sides of the throat, best seen when the animal inflates itself, or when the skin is extended laterally; occipital casque narrow, produced, armed above with three dentated ridges, one on each side, and another along the centre; back with a ridge of short conical tubercles, inclined backwards; chin and throat with a short, dentated longitudinal fringe; scales of the body small and granular; temples divided longitudinally by a dentated ridge.

“*Hab.* Algoa Bay. One specimen, $4\frac{1}{4}$ inches long.”

7. CALUMMA.

Nose and chin simple; orbits rounded. Occiput lozenge-shaped, produced behind, and shelving on the sides, with very large flaps on the hinder side edges. Back compressed, with a series of compressed conical scales. Chin and belly rounded, not dentated, without any line of conical scales (female).

1. CALUMMA CUCULLATA.

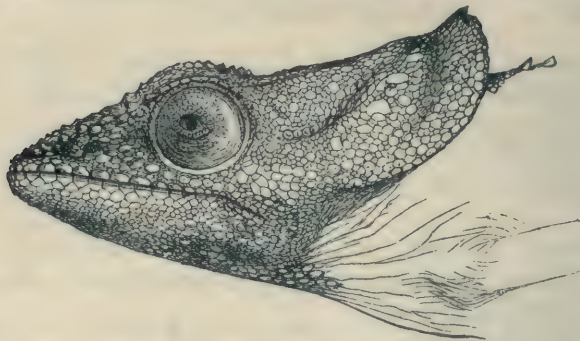
B.M.

Chameleo cucullatus, Gray, Cat. B. M. 267.

Bradypodium cucullatum, Fitz. Syst. Rept. 43.

Hab. Madagascar. A single female specimen.

A. Duméril (Arch. du Mus. vi. t. 22. f. 9) figured a "*C. capuchon*" with a well-marked dentated line of scales on the chin. It is a



Calumma cucullata.

very distinct species. Described above (at page 346) as *C. monachus*.

B. *Nose simple ; orbit angularly produced in front.*

8. BROOKESIA.

Nose of both sexes simple. The eyebrows produced above into triangular horns. Scales very minute. Chin, back, and belly not toothed ; the sides of the back with a longitudinal series, and the chin with an arched series, of subulate erect scales. Tail short, compressed at the base.

1. BROOKESIA SUPERCILIARIS.

B.M.

Chamæleo superciliaris, Kuhl.

C. Brookesianus, Gray, Cat. B. M. 270 ; cop., A. Dum. Arch. du Mus. vi. t. 22. f. 14.

Chamæleon Brookesii, Fitz. Syst. Rept.

Hab. West Africa.

C. *Nose and orbit of male with cylindrical horns.*

9. TRICERAS.

Chamæleon, § *Triceras*, Fitz. Syst. Rept. 43.

The nose of the male with three horn-like processes, covered with a conical, continuous, horny sheath—one from the front of each orbit, and the other from the middle of the nose. Chin simple. Back, chin, and belly not crested. Occiput flat, with a slightly raised central line. Scales uniform, granular.

1. TRICERAS OWENII.

B.M.

Chameleo Owenii, Gray, Cat. 269 ; Zool. Misc. t. 4 ; cop., A. Dum. Arch. du Mus. vi. t. 22. f. 10 (head).

♀. *C. Bibronii*, Martin.

Chamæleon Owenii, Fitz. Syst. Rept. 102.

Dark brown in spirits, with several series of oval longitudinal spots ; those on side of back forming a pale band ; eyelid dark-rayed.

Hab. Fernando Po (*Capt. Edw. Owen*).

D. *Nose with one or two bony processes covered with scales ; orbits simple, unarmed.*

10. CRASSONOTA.

The nose (of male?) compressed in front, with a flexible compressed lobe covered with scales. Chin simple ; orbit rounded. Back rounded, with a series of small, distant, slender, flexible, single scales. Chin and belly rounded, not dentated. Tail rounded above. Occiput flat above, produced behind, shelving on the sides, and covered with small scales. Scales equal, thin.

1. CRASSONOTA NASUTA.

B.M.

Chameleo nasutus, Gray, Cat. B. M. 268 ; A. Smith, Zool. S. Africa, App. 3 ; A. Dum. Arch. du Mus. vi. t. 22. f. 4 (head bad).

Chamæleon nasutus, Fitz. Syst. Rept. 42.

Pale brown ; belly paler ; head and limbs white-spotted.

Hab. Madagascar.

Var. "With three isolated spines, each about a line in length, on the vertebral line, about midway between the head and the base of the tail.

"*Hab.* Eastward of Port Natal.

"Length : head and body 1 inch 10 lines ; tail 1 inch 9 lines. Appears to be an adult." (*A. Smith*, l. c.)

11. ENSIROSTRIS.

Nose (of male, at least) with a single central compressed bony horn, sharp-edged above. Orbit rounded. Chin and belly simple, not dentated. Back and tail with a high crest of roundish lobes covered with scales. Occiput keeled, acutely produced behind, shelving on the sides, and with a broad hood-like lobe covered with scales on each side behind ; scales unequal, granular, with larger rounded scattered tubercles.

1. ENSIROSTRIS MELLERI.

B.M.

Stuffed, grey-brown, with whitish cross bands on the body.

Hab. E. Africa, on the mountains in the interior (*Dr. Meller*). A single specimen, probably a male.

The head and hood are somewhat like those of *Calumma cucullata* ; but the back-crest and the scales are very different, too different to be sexes of the same species, as I was once inclined to think they might be.

12. SAUROCERAS.

Nose (of male, at least) with a single central elongated bony horn, with a deep angular channel on the upper, and a sharp edge on the lower side. Orbit rounded. Back rather compressed, with a series of compressed conical scales. Tail compressed above. Occiput keeled, acutely produced behind, shelving on the sides, with a raised edge below, covered with small scales behind. Scales unequal, granular, with large interspersed tubercles.

Ann. & Mag. N. Hist. Ser. 3. Vol. xv.

1. SAUROCERAS RHINOCERATUM.

B.M.

Chameleo rhinoceratus, Gray, Cat. B. M. 267.*Hab.* Madagascar. A single small specimen.

13. DICRANOSAURA.

Nose of male produced on the sides into two compressed bony horns covered with scales; of female, simple, hornless. Orbit rounded. Occiput flat above, produced, broad, and rounded behind, with small scales on its hinder sides. Back compressed, keeled, sometimes dentated in front. Chin and belly not toothed. Scales equal.

1. DICRANOSAURA BIFURCA.

B.M.

Chameleo bifurcus, Gray, Cat. B. M. 268; A. Dum. Arch. du Mus. vi. t. 22. f. 3.

Chamæleon Brongniartii, Fitz. Syst. Rept. 42.

Nose-horns elongate; back dentated in front. Grey (in spirits), with a broad white streak down each side of the belly; scales equal, square.

Hab. Madagascar. Male and female.

Var. *crassicornis*.

B.M.

One of the males, with the horns only partly developed, has them very thick and trigonal at the base, so as nearly to reach across the nose. In another young male, about the same size, they are compressed and far apart at the base, as in the type specimens.

2. DICRANOSAURA PARSONII.

B.M.

Chamelea Parsonii, Gray, Cat. B. M. 264; A. Dum. Arch. du Mus. vi. t. 22. f. 12.

Chamæleon Parsonii, Fitz. Syst. Rept. 42.

The nose-horns erect, lobed; back rounded, not dentated in front.

Hab. Madagascar.

There is only a female of this species in the Museum.

14. CYNEOSAURA.

Nose of both sexes flat in front, with the sides dilated, serrated, and covered with large scales. The occiput flat, with a sharp-edged, narrow, central keel above, produced, broad, and rounded behind. Orbit simple. Back compressed, with a series of large compressed scales. Chin and belly dentated. Scales unequal.

1. CYNEOSAURA PARDALIS.

B.M.

Chameleo pardalis, Gray, Cat. B. M. 266; A. Dum. Arch. du Mus. vi. t. 22. f. 11 (head).

Bradypodium pardalis, Fitz. Syst. Rept. 43.

Brown in spirits, with a broad white streak down the middle of the sides.

Hab. Bourbon; Madagascar.

MISCELLANEOUS.

On the Occurrence of Cucumaria digitata in the Firth of Forth.

By ROBERT O. CUNNINGHAM, M.D., Prestonpans.

As the gigantic Sea-Cucumber (*Cucumaria digitata*) must be regarded as one of the rarer Echinodermata of the Firth of Forth, I may mention that I obtained a fine specimen of it in the summer of 1863. It measured upwards of a foot long, was of a fine mottled purple colour, and lived for a considerable time in a state of captivity.

On the Milk-dentition of the Walrus. By Professor PETERS.

Malmgren has stated that Wiegmann's formula for the milk-dentition of the Walrus, namely, $\frac{5}{4} \frac{1}{1} \frac{6}{8} \frac{1}{1} \frac{5}{4}$, is incorrect, and that the true formula is $\frac{4}{4} \frac{1}{1} \frac{6}{6} \frac{1}{1} \frac{4}{4}$. He indicates that Wiegmann's notion was founded upon a single case in which the presence of an alveolus already filled up led to the supposition that there was a fifth upper molar; but states that, after an examination of many skulls of the Walrus of various ages, he has never found any trace of this fifth molar. If, therefore, a fifth molar should occur *in the great gap between the third upper molar and the fourth milk-molar*, this must be regarded as an abnormal case.

The Berlin Museum has received the skull of a young Walrus apparently about a year and a half old, which, besides the permanent teeth, $\frac{8}{3} \frac{1}{1} \frac{1-1}{0} \frac{1}{1} \frac{3}{3}$, still exhibits in the lower jaw the two outer milk-incisors, and in the upper jaw, on the right side, the fourth and fifth, and on the left side the fourth and the shallow alveolus of the fifth milk-molars. The position of these teeth is so regular on each side, *not between the fourth milk-molar and the third permanent molar, but further back, and nearly on the same transverse line with the hinder margin of the maxillary zygomatic process*, that they cannot well be regarded as abnormal structures, and therefore furnish new evidence of the correctness of Wiegmann's formula.

The knowledge of the milk-dentition of this animal is of the more consequence, because it is only by it that we can explain the supernumerary teeth in the mouth of the mature animal, which are to be regarded as abnormally late-developed milk-teeth. Amongst these, in the author's opinion, are to be reckoned not only a large fourth molar in the lower jaw, which occurs in two half-grown animals and one mature one, and, singularly enough, only on the left side in all three, but also an anomalous second incisor on the right side of the upper jaw, which has the form of a mushroom, and occurs in a skull having tusks more than half a mètre in length. Wiegmann also cites an observation of Fremery's upon the occurrence of five true upper molars, of which the two hindermost were very small, as a confirmation of his view.

With regard to the systematic position of the Walrus, it cannot be denied that the affinity between the *Lutrina* and *Pinnipedia*, indicated upon osteological grounds by Steenstrup and Sundevall,

is very great, and even that in many points the Walrus and the *Otariæ* agree more with *Lutra* than with the *Phocina*. But the author cannot find in this an uninterrupted transition from the *Feræ*, through the *Lutrina*, to the *Pinnipedia*, but shows that, independently of the dentition, the *Pinnipedia* are rather allied to the Bears by other anatomical peculiarities, such as the development of a hooked process of the lower jaw and the racemose construction of the kidneys. Hence he thinks that the question of the retention or abolition of the *Pinnipedia* as a separate group must depend solely upon individual opinions which hardly admit of discussion.—*Monatsber. der Akad. der Wiss. zu Berlin*, December 1864, p. 685.

Second Note on the Metamorphoses of Marine Crustacea.

By M. Z. GERBE.

In a second note on *Phyllosoma*, M. Gerbe describes the internal anatomy of the Crustaceans composing that supposed genus.

The digestive apparatus consists, as in all Crustacea, of a mouth, œsophagus, stomach, and intestine, with peculiar glands attached to the latter; but the arrangement of these parts is different from that occurring in the adult, as also in other larvæ.

The mouth, situated about the posterior third of the cephalic shield, is circumscribed by a languette and a bifid labium, and by two mandibles. These are followed posteriorly by two pairs of maxillæ and three pairs of footjaws, placed upon two lateral diverging lines. The appendages representing the first pair of footjaws are reduced to scarcely perceptible tubercles, almost confounded with the base of the second maxillæ; those of the third pair, on the contrary, are greatly developed and furnished with flagelliform appendages, and perform the function of natatory feet, which they precisely resemble in organization.

The œsophagus is short, cylindrical, and directed obliquely from behind forwards; it communicates with the front of the stomach by an aperture in the form of an X, formed by a triangular lip moved by two very long and slender muscles, which are attached near the ocular peduncles. This arrangement seems to be peculiar to the Phyllosomes; nothing of the kind has been observed in the larvæ of *Cancer*, *Maia*, *Porcellana*, *Palæmon*, &c. In these larvæ the œsophagus, at its junction with the stomach, only presents a sort of constriction, which dilates and contracts by the action of circular muscles.

In all these larvæ, moreover, the front of the stomach nearly touches the ocular peduncles, as in the adults, and only occupies a very small portion of the cephalic region. Its general form is that of an almond; so that it is rather compressed than globular, and presents two unequal extremities, the anterior of which is the larger. In this form its structure is already very complicated, especially in the larvæ of *Homarus*, *Porcellana*, and *Palæmon*. Its double, muscular and mucous wall is supported by several cartilaginous pieces of extreme transparency. Two of these, forming the floor, articu-

lated to each other, moveable, and projecting internally, are armed with stiff bristles, regularly arranged in rows, like the hairs of a brush. Other hairs, of larger size and more flexible, spring from the roof of the organ, and from its pyloric appendages. Lastly, its cavity may be divided into two distinct compartments, viz. a short, narrow one, nearly cylindrical, immediately following the œsophagus, and a larger one, anfractuous in form, which communicates with the intestine by a contractile circular orifice, surrounded by projecting, ciliated, pyramidal languettes. Thus in most larvæ, both of *Brachyura* and *Macrura*, the stomach agrees in structure and position with that of the adult animal.

In the *Phyllosomes* the stomach is comparatively smaller, and more elongated and compressed. Instead of being close to the ocular peduncles, it occupies the posterior third of the cephalic buckler. From the upper lamina of this buckler it is separated only by the median or ophthalmic artery; its lateral surfaces are entirely free, and its lower surfaces rest partly upon the œsophagus. Its cavity is quite undivided; and its walls, formed by a muscular and a mucous layer, are sustained only by extremely simple cartilaginous laminæ. But it presents the stiff bristles which spring from the projecting laminæ of the *Zoëas*, &c., and the vibratile cilia which keep the organic molecules of the animal's food in constant rotation. It also presents the six pyramidal villous languettes surrounding the pyloric orifice, and projecting into the intestine. This structure of the pylorus seems to be common to the larvæ of *Decapoda*.

The same comparative simplicity of structure is presented by the intestine of the *Phyllosomes*. It extends in a straight line from the pylorus to the anus; it is slender, with its walls a little thicker than those of the stomach; it is nearly of the same size throughout, but is divided by a valvular constriction into two distinct portions, of which the anterior, which is very long, represents the duodenum, and the posterior, very short, the rectum. The latter terminates in an oblique, oblong anal orifice, furnished with two lips moved by numerous and powerful muscles, which are attached to the sides of the last segment.

In the *Brachyura* and some *Macrura*, the intestine, at birth and even during the ovarian evolution of the embryo, presents, at the pyloric region and at the extremity of the duodenal portion, some small ampullæ, which, by subsequent development, become the long membranous appendages of the intestine in the adult. The *Phyllosomes* present nothing of the sort, and the *liver* is the only secretory organ of the digestive apparatus.

In larvæ of which the development is not far advanced, this organ consists of two simple short cæca, springing from the pyloric region at the point where the double vitellary duct of the umbilical vesicle opens, and lying upon the lateral and anterior portions of the cephalic buckler. During development these cæca soon bifurcate, and the two canals thus produced pass between the laminæ of the anterior buckler. The inner canal, as it enlarges, becomes dilated into a

clavate form ; the outer canal undergoes more profound modifications. From its outer border a series of secondary cæca soon arises, and these elongate and become subdivided, until the whole resembles a double, hollow, palmated organ, with its trunks slightly flexuous. The organization of this primitive liver appears to be very simple ; the walls of its numerous tubes are delicate and transparent, and formed of two layers analogous to those of the intestine, which they also resemble in the faculty of contraction and dilatation. The liver of the other Crustacean larvæ, however different in arrangement, has the same origin and organization ; it may be seen alternately extremely dilated and much contracted. The larvæ of *Mysis* and *Porcellana* are particularly remarkable in this respect.

The liver, consequently, is here a diverticulum appended to the intestinal canal ; and at this period the communications between the two organs are so wide, that the nutritive molecules poured by the umbilical vesicle into the cavity of the intestine pass freely from the latter into the future biliary ducts, and *vice versâ*, as they are impelled by the contractions of those organs. It is difficult to say whether, at this point of organization, the liver furnishes any products of secretion to the intestine. If such products exist either in the cæca of the gland or in the intestine, they are so scanty and colourless as to be inappreciable.—*Comptes Rendus*, January 9, 1865, p. 74.

Note on a new Case of Reproduction by Gemmation observed in an Annelide of the Gulf of Suez. By M. L. VAILLANT.

The animal observed by the author belongs to the group of Syllidians, but is not further determined. It is only a little more than four millimètres in length, and presents eight segments, each having a pair of cirri, furnished with eight or ten smooth setæ upon two-thirds of their length, and bristling with small verticillated spines in their terminal third. In front, upon what was apparently the dorsal side, there was a process in the form of a rounded leaf, beneath which was a bundle of tentacles and the buccal aperture. The little animal was found in a cavity of a Sponge.

The segment which bears the leaf-like process presents the most important modifications. It is much broader than the rest of the body, and forms a sort of cup or funnel, compressed from the ventral to the dorsal surface, so as to represent two thick lips, of which the lower is smooth and simple, whilst the upper one is covered with an immense number of buds, placed very close together, and inserted quincuncially.

These buds have a very remarkable form, resembling that of some low forms of Annelides allied to *Nemertes* or *Planaria*. They have a very contractile body, nearly equal in length to that of the parent animal, flattened and obtuse at the free extremity, where they present two or four small black oculiform points. They present only an annulated integument and a few cell-nuclei in the more advanced individuals. Towards the point of attachment, the body becomes

narrowed into an elongated peduncle ; and if this is broken, the little creature moves freely in the water by movements of its body. No vibratile apparatus could be detected.

The author says that these bodies cannot be parasites, on account of the continuity of their tissues with those of the animal ; and he does not think they can be regarded as oculiferous tentacles, because great mobility of the eyes occurs only where those organs are very few in number.—*Comptes Rendus*, February 27, 1865, p. 441.

On the Normal Occurrence of only Six Cervical Vertebrae in Choloepus Hoffmanni, Peters. By PROFESSOR PETERS.

As a general rule, all the Mammalia have seven cervical vertebrae, the only known exceptions to this rule being found in the genera *Bradypus* and *Trichechus*, Linn. (*Manatus*, Cuv.). The species of the former usually have nine cervical vertebrae, rarely eight* or ten. In the latter the normal number is six.

In 1858 the author described a new species of two-toed Sloth from Costa Rica, under the name of *Choloepus Hoffmanni* †; and he has since received perfect and imperfect skeletons of this species which present a second example of the occurrence of six cervical vertebrae among Mammalia, and at the same time furnish an additional character for the distinction of this short-toed species from the long-toed *C. didactylus* from the north of Brazil and Guiana, which has the normal number of seven vertebrae in the neck.

The total number of vertebrae is forty-six in five of the skeletons ; in a sixth, very young specimen, the last caudal vertebrae have been cut away. All of them have only six cervical vertebrae. Of these skeletons, four have all the cervical vertebrae separate ; one has the second and third vertebrae anchylosed together, as observed by A. Wagner ‡ in *C. didactylus* ; and one presents, in addition to this, an anchylosis of the sixth cervical with the first dorsal vertebra. Four skeletons have 23 dorsal vertebrae and pairs of ribs, 3 lumbar and 8 sacral vertebrae ; one has 23 dorsal, 4 lumbar, and 7 sacral vertebrae ; and one exhibits 24 dorsal vertebrae and pairs of ribs, only 2 lumbar vertebrae (the first lumbar being reckoned as dorsal, from its having ribs), and 8 sacral vertebrae. All, with the exception of the damaged young animal, have 6 caudal vertebrae, of which the last two are anchylosed in one specimen.

Throughout the Sloths there appears to be a great tendency to the formation and anchylosis of bones. To the observations already recorded upon this subject the author adds that sometimes in *Bradypus* (*tridactylus*) the hyoid bone and its cornua are amalgamated

* This number occurs generally in *Bradypus torquatus*, which may be regarded as the type of a distinct genus, on account of differences in the form of the skull, hyoid bone, and humerus : for this, if established, Professor Peters proposes the name of *Scæopus*.

† Monatsber. Berl. Acad. 1858, p. 128.

‡ Schreber's 'Säugethiere,' Supplement iv. p. 155.

into a simple arch, and the zygoma may be anchylosed with the zygomatic process of the temporal bone ; and that both in *Bradyppus* and *Cholæpus* the two arms of the stapes are at first separate, and subsequently become converted, by the deposition of new bony matter, into a plate or columella, which may be regarded as the normal form of this ossicle in these genera.—*Monatsber. der Akad. der Wiss. zu Berlin*, December 1864, p. 678.

On the Transformation of the Ocular Peduncle into an Antenna observed in a Species of Palinurus.

On the 21st of November, 1864, M. Alphonse Milne-Edwards communicated to the Academy of Paris the following abnormal condition of the eye of a Langoustian Crustacean (*Palinurus penicillatus*, Olivier) which had been sent to the Museum, among many other specimens of Crustacea, by M. Roget de Belloquet, from the Isle of Mauritius.

On the right side all the organs were normally developed, and so on the left, except the eye, which, instead of being so, carried a long multiarticulate filament, similar in all respects to the terminal filament of an antenna.

The ocular peduncle preserves its basal part in its ordinary form ; and even a rudimentary cornea is visible, from the centre of which the filamentary appendage grows. Its length is about 4 centimètres. It is finely articulated, and furnished with hairs upon the superior border of its terminal portion, disposed in a manner similar to those of the inferior filament of the true antennæ.—*Comptes Rendus*, tom. cix. p. 851.

On a new Antelope from Zambesia. By Dr. J. KIRK.

NESOTRAGUS LIVINGSTONIANUS, n. sp.

Shupanga and Lupata, where it is named "Rumsa" or "Lumdsa."

This small Antelope is very nearly allied to *N. moschatus* of the island of Zanzibar, under which name it is probably mentioned in Dr. Peters's 'Mammalia.' Yet it seems to me different from that of Zanzibar, of which I have seen three recently killed specimens in that island. The size of the two animals is nearly the same ; the colour of that on the Zambesi lighter, and the hair softer, the ears larger and broader, horns more closely ringed, and nostrils more narrowed.

The habits of this Antelope resemble those of the Zanzibar animal ; it frequents dense underwood jungle ; lives in pairs. On being started, it runs quickly, not unlike a hare, turning quickly, and concealing itself in some tuft of grass or small bush.

It seems to me that between the specimen in the British Museum from Zanzibar and the head from the Zambesi there are specific differences, sufficient to justify the latter being at present regarded as a distinct species. Better specimens of both are much needed.—*Proc. Zool. Soc.* Dec. 13, 1864.

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XXXVI.—*Notes on Prof. Steenstrup's Views on the Obliquity of Flounders**. By Prof. WYVILLE THOMSON, LL.D., F.R.S.E., M.R.I.A., F.G.S.

[Plate XVIII.]

ANY contribution from the pen of the accomplished author of the 'Alternation of Generations' must be welcome; and the present communication "On the Migration of the upper Eye of Flounders, across, through the Head, from the blind side to the eye-side," almost vies in novelty with the author's earlier memoir. The original paper is in Danish, and consequently a sealed book to most English students; and many interesting points are omitted in Prof. Steenstrup's French letter to M. Milne-Edwards. We shall therefore commence with a tolerably full abstract of the communication to the Danish Academy, reserving any remarks we may have to offer until the reader is in full possession of the author's views.

I.

The general fact of the obliquity of the Pleuronectidæ is well known. All Flounders have a high compressed body, whose two sides are unequally developed. This want of symmetry is universally accompanied by another peculiarity: both eyes are brought round to one side of the head, so that the fish acquires an eye side and a blind side. The former is coloured and turned upwards towards the light; the latter is colourless or white, and turned downwards in motion or rest. The fish moves or lies

* J. Japetus Sm. Steenstrup:—'Om Skjaevheden hos Flynderne, og navnlig om Vandringen af det övre Öie fra Blindsiden til Öiesiden tvers igjennend Hovedet.' Kjöbenhavn, 1864. Saerskilt Aftryk af Oversigt over d. K. D. Vid. Selsk. Forhandl. i Nov. 1863.

"Observations sur le Développement des Pleuronectes." Par M. Steenstrup. (Annales des Sciences Naturelles, Novembre 1864.)

upon one side as upon a ventral surface, swimming by the undulation of the horizontal unpaired fins.

A new system of equilibrium is established for the Flounders, in which the dorsal and ventral instead of the lateral halves become symmetrical in outline and are equipoised. In most of the Pleuronectidæ, *e. g.* in *Platessa*, *Hippoglossus*, and *Solea*, the left side is the blind side; but in some groups, *e. g.* *Rhombus* and the young forms termed provisionally *Plagusia*, the right side is blind, and the left side bears the eyes. In both of these groups, however, there occasionally occur "wrong Flounders"—dextral Flounders in the sinistral group, and *vice versa*.

Besides "right" and "wrong" Flounders, we have in each group "double Flounders," individuals in which both sides are nearly equally developed and coloured. These have the eyes placed, one in its ordinary position on the eye-side, and one on the top of the head. They approach the ordinary fish-form, and swim vertically; nevertheless they must be regarded as monsters among the Pleuronectidæ.

The external obliquity of the Flounders is accompanied by important structural deviations. The muscular system of the blind side is much more feebly developed than that of the eye side. The fins are smaller, and, even in the unpaired fins, the lower halves of the fin-rays are weaker. The gills and gill-covers are smaller, and the skin is usually less fully developed. The anterior portion of the face is twisted round, so that the whole mouth is bent towards the blind side, while at the same time the posterior part of the face, in which the eyes are placed, is strongly pressed over to the eye side. There is added to this a remarkable removal of certain portions of the most central part of the face; and this it is which, in connexion with the twisting just mentioned, ultimately brings the eyes into their normal position for each species—both on the same side of the head. This latter condition is universal among Flounders, and may be regarded as essentially characteristic of this curious group.

II.

To understand this clearly, we must determine accurately the position of the eyes of a Flounder with reference to the surrounding parts. The two eyes are not placed in a straight line one above the other: the upper eye is either somewhat behind or somewhat before the lower—usually behind; before in the Soles and the *Plagusia*. The eyes are in opposite positions; their upper margins are turned towards one another, and the lower margin of the upper eye is turned upwards towards the dorsal line of the fish. Between the eyes there stretches a firm bony partition (Mellembalk) formed of definite cranial bones. In the

bony cranium there is a single orbit, entirely surrounded by bone, containing the upper eye only; the lower eye lies outside the orbit, and is protected above by the bones which form its lower margin. These bones are always found to be the frontals and prefrontals belonging to the eye side; and as the lower eye lies under these, it is evident that it is in the usual position with reference to the forehead of its own side. The upper eye, which from its position may be regarded as having belonged to the blind side, and which will be shown to have been seated on the blind side at an earlier stage, lies within the orbit, whose lower border consists of the above-mentioned "partition;" its upper margin is composed of the frontal and prefrontal bones of the blind side. "From this it directly follows that the eye of the blind side has come round to the (inner) side of the frontal bones of the blind side, which is turned towards the middle line, instead of lying at the outer (now upturned) side."

The partition between the eyes, instead of being formed equally from the right and left frontals and prefrontals, is formed only by those of the eye side, right or left, or at most with the addition of a small plate from the frontal bone of the blind side; whilst the remainder of the bone-mass formed by the frontal and prefrontal of the blind side surrounds the lower or upturned margin of the eye, forming the margin of the orbit next the dorsal line. "There is thus an unmistakeable encompassing of the parts, which apparently goes beyond all rule—nay, even beyond all analogy; for usually when parts with definite relations to one another change place, forwards or backwards, upwards or downwards, inwards or outwards, in an organism, the associated parts are moved more or less in the same direction, so that the relative position of the parts remains in the main unchanged." To this rule the different relations which the upper eye in the Flounder bears to its frontal bones forms an exception, which can only be accounted for by a moving round of the parts upon one another. The hitherto received explanation, that the abnormal position of the Flounder's eyes is due simply to a greater or less degree of torsion of the whole head upon the axis of the body, or of a part of the head upon the axis of the head, must therefore be regarded as insufficient, since this position could not have been attained without an actual removal of parts of the head. In many forms the eyes lie close to one another, and the partition between them is quite narrow; while in others the partition is even twice as broad as the diameter of the eye. Sometimes the upper eye lies before the lower, and sometimes behind it—in some cases so far behind it as to seem to rest on the back of the head or the nape of the neck. Notwithstanding all these varieties in position, the relations of the upper eye to the

surrounding bones of the head remain the same in all forms : in all the orbit is excavated in the middle of the forehead, so that the frontal and prefrontal bones of the two sides enclose the eye between them, either immediately between them (as in most Flounders) or so that a narrow plate of the frontal of the blind side helps that of the eye side to circumscribe it beneath (as in the Turbots, Soles, &c.).

A careful analysis of the head in the various groups of Flounders shows that a considerable displacement of associated parts has taken place in a definite direction, the displaced parts still maintaining their original relations in position to one another ; the position of the upper eye in relation to its frontal bones (the bones of the blind side) is, however, quite an abnormal one, and cannot be explained by such a displacement or torsion in association with the surrounding parts. Under the generally admitted and correct supposition that the Flounders are not only originally symmetrical, but that they retain this character, and have an eye on each side of the head, for some time after exclusion from the egg, "it becomes necessary to admit that the eye of the blind side, from its original position at that side of the head, has undertaken a movement, deeper and deeper in, under the half-roof which the frontal bone of this side formed over it, and has been brought up through its vault ; so that, in order to find room for itself, it has partly separated the frontal bones from one another, partly made its way through the mass of the frontal bone itself." In other words, the eye could not possibly have reached its final position without having passed obliquely in, and up through the head, and come out at the other side. As the nerves and muscles of the eye directly connect it with the bottom of the orbit, the eye must have first passed under the frontal bones, and then up through them. Were we to attempt to explain the new position of the eye by torsion only, the nerves and muscles must have passed over the frontal bones of the blind side, and must lie permanently in that position, which is not the case. The eye, in leaving its original site, however, has attempted to carry the frontal bone of its own side along with it ; but the greater part of this bone-mass has resisted, and has remained in its place. The Flounder has thus acquired a firm bony bridge extending from the snout to the back of the head and the vertebral column, and of the utmost importance in connexion with its new condition of equipoise.

III.

The passage of the eye obliquely up through the head is finally proved by direct observations on young Flounders. Mi-

nute pellucid Flounders have been described from the Mediterranean by Rafinesque (under the name of *Bothus diaphanus*, Raf.), and by Risso (*Rhombus candidissimus*, Risso). During the last few years the University Museum of Copenhagen has received several specimens from various parts of the Atlantic, chiefly through two invaluable assistants whom Professor Steenstrup has enlisted in his service in the pursuit of knowledge, Captains Hygom and Andréa, to the former of whom the present memoir is appropriately dedicated. The Atlantic Plagusieæ are about an inch long, and resemble the Mediterranean forms in having the eyes on the left side, and the unpaired fins passing on to the borders of the cheeks; but the upper eye is rather in advance of the lower, and the dorsal and abdominal unpaired fins form with the tail a continuous fringe round the posterior portion of the body. (Pl. XVIII. fig. 2 *C, C'*, left and right.) Along with these little Flounders some other small fishes were procured (fig. 2 *A, A'*) resembling them in all particulars save in this—that they were apparently quite symmetrical, with an eye on each side of the head. These fishes are Flounders in an earlier stage. Fig. 2 *B, B'* represents another form, taken along with them. At *B'* we have the right side of the head, with an eye in the normal place; at *B* we have the left side, with, strange to say, two eyes in the ordinary position of the eyes of a Flounder. On careful examination, however, we find that the eye on the right side is, as it were, pressed inwards into the head, that a new opening surrounded by a thickened border has been prepared for it on the left side, and that it is just on the point of *breaking through* in the new position, being still partly visible from both sides. If we hold the fish in a suitable position with reference to the light, we may even trace an oblique passage up through the head for the transit of the eye, through which the light passes more strongly than through the surrounding parts. A close examination of the stage figured 2 *A* shows us that it is not quite so symmetrical as it appeared at first sight, but that it has already undertaken many of the preliminaries towards the future Flounder form. The mouth is oblique, and the eyes are not seated at the same height, the left being lower than the right. The sides are not equally developed; and from the right eye an oblique, more transparent path may be detected over to the opposite side, up towards a point which corresponds with the subsequent position of the eye.

“More beautiful transitional steps from the symmetrical to the oblique form than those represented in fig. 2 *A, B, C* could not be given, nor more expressive evidence that the eye actually goes from one side up through the head over to the other side—in other words, that the symmetrical fish by degrees squints

its eye in and up through the head, out to the other side, and at last squints itself into a perfect Flounder."

The other specimens in the museum correspond with the stage fig. 2 *A*, but are not so far advanced. They have characters which indicate that they belong to several species and even genera. It seems, in fact, that at least a whole group of Pleuronectidæ pass through similar early stages; and, from the structure of the mature skulls, it is more than likely that this method of the production of the obliquity of the eyes is universal in the family.

IV.

The author analyses two direct observations which have usually been supposed to support the view that the eyes acquire their final position, both on one side of the head, by a simple torsion of the anterior portion of the head in the young fish. The first of these was made by Professor Van Beneden, and was published by him in the 'Bulletin de l'Académie Royale de Belgique,' t. xx. 1853 ("Note sur la Symétrie des Poissons Pleuronectes dans leur jeune âge").

An extremely minute fish, apparently only recently extruded from the egg, was taken in a fine-meshed net along with Shrimps. The eyes were unsymmetrical—one in its ordinary position, the other higher up, on the top of the head; the dorsal fin came down on the back of the head, but not to the eye; and Van Beneden concludes that a further twist would have brought the eye further down, and that the dorsal fin would then have extended past it over the head.

Prof. Steenstrup gives good reasons for doubting that this very young form was a Flounder at all, and is rather inclined to refer it to *Gunellus*, or some other of the Blenny group. At all events, admitting that it was a Pleuronectid, there is nothing in its structure by any means conclusive against the eye having been ready to perform its migration according to Prof. Steenstrup's view, at a later stage.

The second observation is by A. Malm, Curator of the Göteborg Museum, published shortly after, and independently of, Van Beneden's paper ("Öfversigter Kgl. Sv. Vetenskaps Akademien, 1854"). A young *Rhombus barbatus* (Clocq.), 20 millim. long, was found swimming obliquely near the surface of the water. Its colour was nearly the same on both sides; the lower eye was in its usual place, but the upper eye was on the top of the head. The dorsal fin ceased immediately behind the eye.

Malm assumes, 1st, that he had before him an ordinary stage in the development of the species towards its normal form; 2ndly, that the right eye had reached its position at the top of

the head by a simple torsion of the head on its axis; and 3rdly, that, after the passage of the eye down upon the left side by a further torsion, the dorsal fin would have continued its progress over the head. So far as this observation goes, these are mere assumptions, according to Professor Steenstrup's view extremely improbable; but all the structural peculiarities of Malm's fish are most simply explicable if we suppose the young of a "double" *Rhombus* to have fallen into his hands.

This peculiar malformation is by no means uncommon among Flounders. Its main characters are that both sides are coloured and nearly equally developed, that the eye of the blind side is placed in the middle line at the top of the head, while the eye of the eye side is in its normal position, and that the dorsal fin is arrested immediately behind the upper eye, and sometimes somewhat arched over it.

Donovan gives the first figure of this monstrosity, under the name of *Pleuronectes Cyclops*: he imagined it to be a permanent species. His specimen seems to have been a monstrous Brill. Schleep, in the 'Isis' for 1829, describes two "double" individuals of *Rhombus maximus*, and states that he had met with others. Several "double" Flounders are described from the British coast (Yarrell, Couch, &c.). Among the Plaice, the same monstrosity is cited by Malm and Nilsson in *P. Flesus*, and by Kröyer in *P. vulgaris*. Even in the Soles the same peculiarity seems to be indicated by Yarrell in his notice of *Solea Trevelyana*. The Holibut (*Hippoglossus vulgaris*) seems to be the only common form in which a double variety is not described.

It may seem strange that the single individual taken by Malm should have presented this somewhat unusual modification; we must remember, however, that while the common herd of "right" and "wrong" Flounders move along the bottom, "double" Flounders come to the surface, and within range of a towing-net.

V.

Besides the two marked deviations in form from the normal type of each species ("wrong" Flounders and "double" Flounders), there are likewise deviations in colour—"albinos" and "negros." Albinos, white on both sides, but yet normal in form, are mentioned by many authors: by Kröyer in *Platessa vulgaris* and in *P. Flesus* (quoted from Gottsche); by Schleep in *P. vulgaris*: in this latter case no sexual parts could be detected. Houttuyn describes an albino; and Shaw's *Pleuronectes roseus*, from the Thames, belongs to the same category. Flounders dark on both sides, without any structural malformation (negros), seem also to occur, but more doubtfully. They are mentioned

without reference to any malformation; but a more or less perfect "Cyclopean" position of the eye is so often associated with darkness and plumpness on both sides, that there is every reason to believe there is an essential connexion between the two peculiarities. "Double flounders" have always been held in high estimation for the table. The dark side of a Flounder is always the richer; therefore two dark sides are better than a dark and a light: but the advantage seems to go even further; for both sides of a double Flounder are plumper than the best side in the ordinary type. "Wrong Flounders" are met with in all species, but usually rarely. In *Platessa Flesus* they are so common that they can scarcely be regarded as deviations from the normal form: "wrongness" seems in no way connected with structural deviation.

A singular instance exists of a double monstrosity (so far as we know) universal in a species.

Fabricius first describes *Hippoglossus pinguis* (Pl. XVIII. fig. 3), the "Kalleragleck" of Greenland; a small Holibut very abundant and constantly fished in the deepest of the Greenland fiords, sometimes associated with *H. vulgaris* (fig. 4), but often met with alone and in great quantity, with both sides plump and symmetrical, and the eye in the middle of the head. There seem to be good reasons, from the difference in the form of the teeth, from the differences in the gill-covers and in the distribution of the lateral lines, to believe that *H. pinguis* is not to be regarded as the double monstrosity of *H. vulgaris*.

If this be the case, the "right" form of *H. pinguis* has not yet been observed, and we know the species only from its "double" monsters. We are still ignorant of the conditions of reproduction of *H. pinguis*, which has not yet been described as having either roe or milt.

In the paper of which the above is an abstract the distinguished author has clearly made out his principal and most interesting point—that a simple torsion of the anterior portion of the head of a Flounder on its axis is insufficient to explain the final position of the eyes; and his direct observations on the "Plagusie" prove that the eye of the blind side actually passes from its own side of the head to the other side—at all events, under the integument and under the subcutaneous tissues which contain the rudiments of the dermal bones forming the support of the anterior border of the dorsal fin, if not actually through the head itself.

The conclusion specially insisted upon by Prof. Steenstrup in the first parts of his communication—that the eye of the blind side, in crossing to the eye side, passes under the frontal bone,

and thus actually through the vault of the cranium—is certainly very remarkable, and, as the author admits, apparently beyond all rule and analogy. We must therefore test carefully the facts which are cited in its support.

Two questions naturally arise:—first, Does the eye of the blind side in the mature skull actually rest in an abnormal position with reference to its essentially associated bones? and secondly, At the period when the migration of the eye took place, were the bones in such a position with relation to the eye as to necessitate its reaching its final position by so unusual a course? We agree with Prof. Steenstrup that the position of the eyes in relation to their associated bones is essentially the same in all the oblique heads of the *Pleuronectidæ*. We shall select the head of the Turbot (*Rhombus maximus*), a left-handed Flounder, as an example. Placing the head on its side (Pl. XVIII. fig. 1), in its normal position in the living fish, two strong bony beams connect the snout with the middle of the head; and between these, as Prof. Steenstrup describes, lies the large round closed orbit of the right eye. The left beam, which forms the partition between the eyes, is made up principally of the thickened, contracted anterior half of the left frontal bone (fig. 1 *f'*). This is, however, lined throughout its entire length by a strong sickle-shaped process of the right frontal bone, and this process actually forms the left border of the orbit (fig. 1 *f*). Anteriorly and externally the partition is strengthened for about one-third of its length by an articulating process of the left prefrontal (fig. 1 *a'*). The right beam, forming the right border of the orbit, consists almost entirely of the right prefrontal (fig. 1 *a*) enormously developed and synchondrosed with two strong ridges of the right frontal, which, however, in this species, scarcely project in advance of the posterior edge of the orbit. In the Plaice (*Platessa vulgaris*) they advance a considerable distance to meet the opposing process of the prefrontal. The left eye is in its ordinary place beneath the outer edge of the left frontal, the left prefrontal (as usual) merely eking out the anterior extremity of the upper edge of its orbit.

So far as its right frontal is concerned, the right eye is likewise in its normal position, at the outer edge of the sickle-shaped process to which the anterior portion of the right frontal has been reduced.

So far the relations of the eyes to their associated bones has not been disturbed, though an extraordinary shifting and absorption has taken place, which has removed nearly the whole of the right half of the anterior portion of the right frontal bone from the path of the right eye into its new position, and reduced it to a thin crescentic plate.

But the right eye is in a closed orbit whose right border consists of the right prefrontal; and we must account for the position of the eye within this bone, if possible, without resorting to the extreme view that it passed through beneath it. It must always be remembered that the prefrontal bone has no definite relation in position to the eye, whose capsule is essentially connected with the bones of the frontal arch of the skull only. The prefrontal is an extremely variable bone of the face, in relation with the olfactory sense-capsule, if with any. Prof. Steenstrup's diagrams of the path of the eye from the blind to the eye side beneath the cranial bones are all taken from mature distorted skulls; but at the time of the transit of the eye the fish was symmetrical, or nearly so. The eyes were nearly symmetrical; and it would be only natural to conclude that the bones of the head (or their potential positions) were nearly symmetrical likewise. The left border of the skull remains normal throughout, the parts occupying nearly the same relative positions which they do in the Cod; *i. e.*, the left eye is opposite the lower edge of its own frontal bone, the comparatively small prefrontal merely finishing the anterior edge of its orbit. It is clear that the left eye of the Turbot or either of the eyes of the Cod might migrate across the head under the skin, merely absorbing or pressing before it the frontal bone, without coming in contact with the prefrontal at all. In the Turbot the left prefrontal is nearly normal in size, and not more than half the length of that of the right side; and I think we may conclude that in the symmetrical young both bones were normal and alike, and that the right eye was placed opposite the edge of the frontal bone, which at that time formed a portion of the right edge of the skull. When the change in the position of the eye occurred, this exposed portion of the right frontal, whether potential or actually developed, was pushed or absorbed before the migrating eye and its nervous and muscular connexions, and reduced to the crescentic plate which, in the mature head, lines the left wall of the orbit, still retaining its original position with reference to the eye. At a subsequent stage in the development of the oblique head, the right prefrontal shot out a process backwards across the gap through which the nerves and muscles of the eye had passed, and became articulated to the frontal bone, forming the beam whose immediate relation to the new condition of equilibrium—that is to say, to the obliquity of the fish—is so accurately pointed out by Prof. Steenstrup.

From these considerations we are forced to conclude that the eye of the blind side passed to the eye side, not through the vault of the head, but under its integument, displacing in its progress the frontal bone of its own side—the space through

which its nervous and vascular connexions passed being indicated in the mature skull by the unsymmetrical posterior half of the articulating process of the right prefrontal, the eye having maintained its normal relation to its associated bone (the right frontal) throughout.

The term "migration" of the eye is, of course, used in a somewhat metaphorical sense. The eye changes little in *actual* position. With the growth of the fish the associated parts are, as it were, *developed past it*, producing this singular obliquity.

Nothing can be more startling than the effect produced by the changes in the position of the eye in these young Flounders. We were kindly introduced last summer to the charming little "*Plagusia*" by Prof. Steenstrup in his most instructive museum. At first symmetrical miniature "*jaunes-dorées*;" next the right eye becoming depressed inwards, and a strange little button-hole appearing opposite it on the eye side, giving singularly the effect of a Flounder with three eyes; the eye slipping into the button-hole, and finally all trace of its former socket becoming gradually obliterated. Still, notwithstanding the wonderful appearance of this migration, if our view be correct, but little violence is done to the relations of the parts. The eye was always under the skin, and it merely passes in its course beneath a band of opake integument to emerge under a second "pane" of transparent skin which has been prepared for its reception.

A valuable lesson may be drawn from Prof. Steenstrup's most interesting observations upon "right" and "wrong" Flounders, "double" Flounders, "albinos," and "negros." The dark side of a Turbot is infinitely the more fully developed, the richer, the fatter, the better in every way. According to modern usage, if a Turbot be put on the table, this eye side is turned downwards; and the consequence is that usually, after the thin, meagre blind side has been discussed in the dining-room, most of the best of the fish is sent down to the servants' hall. It may not be the cook's interest to remedy this, but surely it is her mistress's; for, under the present system, no *lady*, at all events, can hope to reach the eye side of a Turbot.

EXPLANATION OF PLATE XVIII.

Fig. 1. Skull of the Turbot (*Rhombus maximus*): *a*, right prefrontal; *a'*, left prefrontal; *f*, right frontal; *f'*, left frontal.

Fig. 2. Heads of *Plagusia* (left and right sides) in three stages of metamorphosis.

Fig. 3. *Hippoglossus pinguis* (Fabr.).

Fig. 4. *Hippoglossus vulgaris* (Flem.).

XXXVII.—*On the Species and Varieties of the Honey-Bees belonging to the Genus Apis.* By FREDERICK SMITH.

[Plate XIX.]

IN 1862 Dr. Gerstäcker published his remarks "On the Geographical Distribution and Varieties of the Honey-Bee, with Observations upon the Exotic Honey-Bees of the Old World"*. Having in my own possession a large amount of material, and also access to that preserved in other collections, I have devoted considerable time to an attentive study of the species. The result has been somewhat different from that arrived at by Dr. Gerstäcker. I have therefore thought it might be desirable that I should publish the results of my own study of the genus.

In my 'Catalogue of the Apidæ' I enumerated fifteen species of the genus *Apis*: one was overlooked at that time, and four I have described since its publication, thus increasing the number to twenty species. In the paper referred to, the fifteen catalogued species, with the addition of two of those which I have subsequently described, are reduced to four by Dr. Gerstäcker: why he passed over the other two, which I described previous to those he has noticed, it is difficult to imagine; but it was probably entirely an oversight. I fully concur in the necessity for the reduction of the number of species effected by this learned entomologist; but I am not prepared to go with him to the same extent: I must therefore endeavour to show good reasons for differing from such an authority.

Our author remarks that "various races of Honey-Bees have been described as distinct species by various authors," but that "they really present no distinctive specific characters." This observation naturally leads to the inquiry, What are the distinctive specific characters in the genus *Apis*? Before I attempt to answer that question I would offer a few remarks upon two or three distinct and extensive genera of Bees, and will endeavour to point out where, under certain conditions, distinctive characters are sometimes to be found. If I were to seek in the females of many species of Bees for the distinctive characters of the species, either in difference of form or in the sculpture of parts, I should in all probability fail to discover any that I could, by description, enable the entomologist easily to recognize; but if I had each species before me in its *entirety*, that is, both sexes of each species, my task would in all probability become a comparatively easy one. My knowledge of the male and female of each species would place me in a position to enter upon the investigation with the necessary materials before me. I should, in the first place, probably find broad and distinctive differences

* Annals, ser. 3. vol. xi. p. 270.

in the males which I could not detect in the other sex; and I should then be able to determine what (however slight they might be) were the distinguishing characters of the females—differences which, under other circumstances, I might probably have regarded as mere marks of variation; but these would then be recognized as characters of full specific value, such as a description would easily point out. This position would apply admirably to many species in the genera *Megachile*, *Osmia*, and *Xylocopa*: the females in these genera are frequently extremely difficult to separate into species; but when we become acquainted with each in its entirety, the difficulty is at once removed. The male sex in these genera frequently presents marked differences of form in the legs, at other times in the armature of the head with horns or spines. In the extensive genus *Nomada* we are frequently compelled to rely for specific distinctions upon differences in coloration, scarcely any presenting themselves in the structural characters of either sex.

The remark that “Honey-Bees really present no distinctive specific characters” would be perfectly true if applied only to *worker Bees*; for, with the exception of difference of size and coloration, no other very satisfactory characters are to be found: one species only would be readily separable from the rest—the *Apis dorsata*, it having a constant distinct difference in the venuration of the anterior wings, and also in the size and position of the ocelli.

What, then, are the distinctive specific characters in the genus *Apis*? These are to be found only in the *entirety of the species*; and I am perfectly convinced that attempts to determine what are species, and what are races, by a study of the *workers only*, must result in the commission of error—little more than difference of size and variety in coloration being the guides for determination.

Dr. Gerstäcker's remark must therefore be understood, in my opinion, as only applicable to the study of the working Bees—by far the least characteristic form of the species. *Apis mellifica* appears to be the only species of which Dr. Gerstäcker knows the *undoubted male*; it is true that he has assigned my species *Apis lobata*, established upon a solitary specimen in the national collection (and in all probability it is correctly assigned), to the Fabrician *Apis florea*, having received both in a collection from Ceylon. I myself possess the males of three species, and a fourth is in the British Museum: each of them is distinguished by strongly marked distinctive specific characters; so that no hesitation can possibly be felt about assigning each to a distinct species of Honey-Bee.

As before observed, I enumerated fifteen species of the genus

Apis in my catalogue; but at that time, I must admit, I had very strong suspicions of several being mere climatal varieties of the others, such varieties as might be reasonably expected to be found in communities of the species; but I felt that I had little or nothing to guide me in arriving at a more correct enumeration. I might have arbitrarily reduced the number, it is true; but such a mode of reduction I felt I was not warranted in making; in fact, I found that, until I became acquainted with the other sexes of these *supposed varieties*, it was far better to let them stand as species until more ample and necessary material presented itself to work upon.

The possession of an extensive series of examples of any species from different localities is doubtless good material for tracing out the variation in colour to which a species is liable. *Apis mellifica* would be an instance of this kind, pregnant in interest. But, at the same time, I must claim, for a series such as I have indicated, that it is a means whereby we may also trace the variation in size to which any species is liable. Therefore, if I investigate *Apis mellifica* in this respect, and examine a large series of examples from all parts of Europe, I include the *Apis ligustica* as a mere variety; and, as I have just observed, my series being extensive and from all parts of Europe, from the Cape of Good Hope, from Natal, Sierra Leone, Australia, New Zealand, from St. Domingo, the Sandwich Islands, also from distant parts of North America, when I compare all these together, I find no really perceptible difference in size in the whole series before me.

In the next place I examine a very extensive series of Honey-Bees from different parts of Africa, and I at once recognize many of *Apis mellifica*, all agreeing as to size, but exhibiting not only the dark unicolorous Bee of northern Europe, but also an extremely bright variety of *Apis ligustica*. I next find a large number of a bright-coloured species, closely resembling *A. ligustica*, but all being uniformly of a much smaller size: this is Latreille's species, *Apis Adansonii*. Varieties of this Bee are described by St. Fargeau under the names *A. scutellata*, *A. nigritarum*, and *A. Caffra*. I entertain little doubt of these three supposed species being varieties of *A. Adansonii*; but until all the sexes of this smaller Bee are obtained, and the males are found to be identical with those of *A. mellifica*, I shall regard the *A. Adansonii* as a good and very distinct species.

My investigation of the genus *Apis* induces me to divide it into seven species: I enumerate eight, but one is founded upon a single example of a drone: this male is from North China, whence I also obtained a worker of my own species, *Apis nigrocincta*; therefore it is highly probable it may prove to be the male of that species.

Dr. Gerstäcker's history of the geographical distribution of the *Apis mellifica* is extremely interesting; but, in my opinion, he has included, as I before stated, a distinct species, the *Apis Adansonii*. I can add somewhat to the range of the European Bee, as our author says "it does not appear to exist in Australia;" it is, however, I am informed, extremely abundant in that country, both in a domestic and also in a wild state; it has, of course, been introduced. It is found in the same way in New Zealand. In the British Museum are examples of *Apis Adansonii* from Australia. The Northern Honey-Bee abounds, in a wild state, in Texas and California; indeed Mr. Lord, who was resident in the former country for a considerable period, told me that it would be very difficult, perhaps impossible, to find a hollow tree untenanted by *Apis mellifica*.

Dr. Gerstäcker divides the genus *Apis* into two groups, each being characterized by different structural peculiarities. After an extensive examination of species, I find two of the characters made use of inconstant, as applied to these divisions, but very useful in the determination of species. I have omitted them in the characteristics of the groups, and will point out the use made of them in dividing the species. The first character consists of the number of transverse rows of short hairs or bristles which line the inside of the metatarsus of the posterior legs. In the division of the Honey-Bees into two groups, those of the first are said to have "thirteen rows of bristles on the inner side of the metatarsus." I make the number of rows to be fourteen. I place two species in this division, and both are so characterized. In the second division, however, the character laid down, as in part distinguishing them (the "metatarsus of the hind legs with nine transverse rows of bristles on the inside"), cannot be retained. In order to ascertain correctly whether the species varied in this particular, I broke off the metatarsal joint from a large number of my specimens, and, having removed the bristles, I was enabled to ascertain with facility the exact number of rows in all the species. The figures given in illustration of this paper show the number in each: in counting the rows, that at the apical margin is, in all instances, included. I presume, such was not the case in drawing up the characters in Dr. Gerstäcker's paper, otherwise the first division would have fourteen rows.

The result of my examination of the different species of the genus *Apis* shows that *Apis dorsata* and *A. zonata* have each fourteen rows of bristles on the metatarsal joint; *A. mellifica*, *A. florea*, and *A. indica* have each ten rows; *A. Adansonii* has nine, and *A. nigro-cincta* eleven rows—a most satisfactory result, since it confirms me in my opinion, founded upon other characters, of the genus *Apis* consisting of more than four

species, the number given by Dr. Gerstäcker in his elaborate memoir.

By reference to the plate, it will be at once seen that the form of the posterior leg of the males of the different species is so distinctively different, that this single character alone is sufficient proof of their being distinct species, although the posterior leg in the other sexes only exhibits slight modifications of form in the metatarsal joint; but these, although less marked, are constant.

The rows of stiff hairs or bristles on the metatarsal joint are each situated on an elevated ridge; so that when the bristles are removed there is no difficulty in reckoning the number.

Group I. Vertex distinctly narrowed by the large compound eyes, so that the posterior ocelli are more distant from each other than from the eyes. In the anterior wings the recurrent nervure issues very near the apex of the third submarginal cell.

Sp. 1. *Apis dorsata*, Fabr. Syst. Piez. p. 370, ♀. (India.)

?*Apis nigripennis*, Latr. Ann. Mus. Hist. Nat. v. 170, ♀. (Bengal.)

— *bicolor*, Klug, Mag. der Gesell. Nat. Fr. zu Berlin, (1807) p. 264, ♀. (India.)

— *zonata*, Guér. Voy. Bélang. Ind. p. 504, ♀. (Coromandel.)

— *testacea*, Smith, Proc. Linn. Soc. ii. 49, ♀. (Borneo.)

(Additional habitats known are Malacca, Ceylon, Java, Sumatra, Flores, and Timor.)

Of this species I possess a good series of varieties of the worker Bees and two males; the latter sex has not been previously noticed: one specimen from Bombay is reddish yellow, with the thorax above, the scape of the antennæ, and the outside of the posterior tibiæ and of the metatarsus black; the thorax and two basal segments of the abdomen are clothed with long pale-reddish hair, intermixed with darker hairs on the disk of the thorax; wings colourless, and much more ample than in the worker Bee.

The second male is that of the pale variety, *Apis testacea*, first taken in Borneo, by Mr. A. R. Wallace, and subsequently in the island of Timor; it is entirely of a pale testaceous yellowish red; the thorax and two basal segments of the abdomen densely clothed with long pale-yellow hair; the wings clear hyaline. Except in coloration, these specimens agree in every particular; the posterior legs are precisely of the same form and length. Had I not possessed the male of this variety, I should have deemed it advisable to regard *A. testacea* as a distinct species. The exact correspondence of the two males in their form and proportions I consider conclusive of their being mere climatal varieties. I am informed by Mr. Wallace that he captured this pale variety on the wing in Timor, and that it sus-

pend its combs from the branches of trees, without any outward protection. This, I am informed by Sir John Hearsey, is also the habit of *A. dorsata* in India. This species varies greatly in the coloration of the abdomen. I have seen the following varieties:—

- a. Head and thorax black; abdomen yellow, with the apex more or less dusky; the anterior wings brown, palest at their posterior margin. (*Apis dorsata*, Fabr.)
- b. Like the previous variety, but with the wings hyaline. India.
- c. Black, with only the two basal segments of the abdomen yellowish red. (*Apis bicolor* and *A. zonata*.)
- d. Varies in having the three basal segments of the abdomen reddish yellow, and a band of white pubescent pile at the base of the fourth and fifth segments; anterior wings brown. Timor.
- e. The head and thorax black, and clothed with pale pubescence; the abdomen and legs entirely pale testaceous; wings hyaline. (*A. testacea*.) Borneo and Timor.

I have added a mark of doubt to the synonym *A. nigripennis* because I do not feel quite satisfied of its being distinct from the next species. I have seen examples of a black Bee from the Philippines which may prove to be a climatal variety of *A. dorsata*: it has not the ocelli so large as the next species.

Sp. 2. *Apis zonata*, Smith, Proc. Linn. Soc. iv. 8, ♀. (Celebes.)

Apis dorsata, Gerst. Ann. & Mag. Nat. Hist. (1843) xi. 344, nec Fabr.

This species is entirely black; it is the largest at present known of the genus; it is 9 lines long, whilst the *A. dorsata* I never found to exceed $7\frac{1}{2}$ lines. The abdomen, in all the specimens that I have seen (nineteen or twenty), is very convex above, and is adorned with a band of snow-white, short pubescent pile on the basal margins of the third, fourth, and fifth segments; these bands are continued beneath. Dr. Gerstäcker considers this species as an extreme variety of *A. dorsata*; but in this I cannot agree. The size, colour, and convexity of the abdomen are different, in addition to which I find a difference in the form of the metatarsus; the ocelli are proportionally larger, and the face is not pubescent. These may be regarded as slight differences; but, as I have already remarked, the specific distinctions among the workers of the different species of Honey-Bees are always extremely slight. The capture of the other sexes will, no doubt, decide this question; but I am inclined to believe that *A. zonata* will prove to be a good species.

Group II. Vertex not perceptibly narrowed; the posterior ocelli not more distant from each other than from the compound eyes. The recurrent nervure distant from the apex of the third submarginal cell.

Sp. 3. *Apis mellifica*, Linn. Faun. Suec. p. 421. no. 1697, ♀.
(Europe.)

Apis ligustica, Spin. Ins. Ligur. i. 35. 15. (Italy.)

— *fasciata*, Latr. Ann. Mus. Hist. Nat. v. 171. (Egypt.)

— *cerifera*, Scop. Ann. Hist. Nat. iv. 16. (Europe.)

— *gregaria*, Geoffr. Ins. ii. 407. (France.)

— *domestica*, Ray, Hist. Ins. p. 240. (England.)

Of the unicolorous form of this species I have seen specimens from nearly all parts of Europe, from most of the West-India Islands, from New York, Canada, Florida, Texas, California, and Mexico, from the Cape of Good Hope, Sierra Leone, Australia, and New Zealand; of the Ligurian form, examples from Italy, Switzerland, and the Cape of Good Hope.

Sp. 4. *Apis Adansonii*, Latr. Ann. Mus. Hist. Nat. v. 172, ♀.
(Senegal.)

Apis scutellata, St. Farg. Hym. i. 404, ♀. (Africa.)

— *nigritarum*, St. Farg. Hym. i. 406. (Congo.)

— *Caffra*, St. Farg. Hym. i. 402. (Africa.)

? — *unicolor*, Latr. Ann. Mus. Hist. Nat. v. 168. (Madagascar.)

— *mellifica*, Gerst. Ann. & Mag. Nat. Hist. 1863, vol. xi., nec Linn.

As I have before remarked, Dr. Gerstäcker regards this species, together with its varieties, as identical with *Apis mellifica*. My reasons for differing from him will be found in the foregoing remarks. I have also ascertained that the Honey-Bee is found in Zambesi: this small form I am inclined to consider a native species, widely spread over the vast expanse of Africa. The capture of the male will in all probability prove the truth of my conclusions. The *Apis unicolor* I have never seen; I have therefore expressed a doubt as regards its synonymy.

Sp. 5. *Apis indica*, Fabr. Syst. Piez. p. 370, ♀. (India.)

Apis Peronii, Latr. Ann. Mus. Hist. Nat. v. 173, ♀. (Timor.)

— *Delessertii*, Guér. Icon. Règ. Anim. 461, ♀. (Pondicherry.)

— *Perrottetii*, Guér. Icon. Règ. Anim. 461, ♀. (Neelgherries.)

— *socialis*, Latr. Ann. Mus. Hist. Nat. iv. 172, ♀. (India.)

— *dorsata*, St. Farg. Hym. i. 405, ♀. (India.)

(To the above localities may be added Java, Sumatra, Flores, Malacca, and Borneo.)

Sp. 6. *Apis nigro-cincta*, Smith, Proc. Linn. Soc. v. 93, ♀.
(Celebes.)

Apis indica, Gerst. Ann. & Mag. Nat. Hist. 1863, vol. xi. 343, nec Fabr.

This species has also been received from Borneo and China—

several specimens from the latter locality, all found near Shanghai. It is probable that the species described in this paper as *Apis sinensis* may prove to be its male: it was taken with the above-mentioned specimens. Dr. Gerstäcker regards this species as a variety of *Apis indica*, and places it among the varieties of that species which are characterized as having only the anterior part of the first and the basal half of the second segment yellow, the remainder blackish brown; my description is, with the abdomen entirely pale reddish yellow, and a narrow black band on the apical margin of all the segments.

I consider the species distinct from *A. indica* for the following reasons: it is uniformly larger, and has proportionally larger ocelli, the anterior one being more advanced and forming a more acute triangle; in front of the anterior ocellus is a strongly impressed channel, which passes down to the clypeus. These characters will probably be considered slight ones; but we must bear in mind that the distinctive specific characters in the genus *Apis* are slight in the working Bees, only one instance, as I have already observed, being known to the contrary, in *A. dorsata*.

Sp. 7. *Apis florea*, Fabr. Syst. Piez. p. 373, ♀. (India.)

Apis andreniformis, Smith, Proc. Linn. Soc. ii. 49, ♀. (Borneo.)

— *lobata*, Smith, Cat. Hym. Ins. Apidæ, ii. 416, ♂. (India.)

— *indica*, Latr. Ann. Mus. Hist. Nat. v. 169, ♀. (India.)

On a careful examination of *A. andreniformis*, I am inclined to consider it an extreme variety of *A. florea*: that species has the two basal segments of the abdomen red; but I have others in which the abdomen is entirely red, the apical segment being slightly fuscous: I find that it varies in colour much more than I was aware of when I described the species. The example upon which I founded it is the only one that I have seen with the abdomen entirely black, the second segment being narrowly rufo-fuscous at the basal margin, whilst the basal margins of the third, fourth, and fifth segments have each a narrow band of white pubescent pile. Dr. Gerstäcker has ascertained that this species is the *Anthophora florea* of Fabricius; he has also received the worker Bees from Ceylon, together with specimens of my *Apis lobata*: for this reason *A. lobata* is assigned as the male; if such prove to be the fact, it will be the first instance of such a vast discrepancy in size occurring in the genus *Apis*, the average size of the worker Bee being $3\frac{3}{4}$ lines, whilst *A. lobata* is 5 lines. I am, however, inclined to Dr. Gerstäcker's opinion, since he has had an opportunity of examining combs of *A. florea*, and he observes that the drone-cells are very large.

Sp. 8. *Apis sinensis*.

Length 5 lines.

This species is of the same colour and general form as the male of *A. mellifica*; but the neuration of the anterior wings is different; the recurrent nervure enters the third submarginal cell nearer to its apex; the difference in the form of the posterior tibiæ is also a distinctive specific character. (See Pl. XIX. fig. 4.)

EXPLANATION OF PLATE XIX.

- Fig. 1. Posterior leg of the male of *Apis mellifica*.
 Fig. 2. " " " *Apis dorsata*.
 Fig. 3. " " " *Apis florea*.
 Fig. 4. " " " *Apis sinensis*.
 Fig. 5. Posterior leg of the Worker Bee of *Apis mellifica*.
 Fig. 6. " " " *Apis Adansonii*.
 Fig. 7. " " " *Apis zonata*.
 Fig. 8. " " " *Apis dorsata*.
 Fig. 9. " " " *Apis nigro-cincta*.
 Fig. 10. " " " *Apis indica*.
 Fig. 11. Posterior metatarsus, showing the number of transverse rows of bristles to be fourteen in *Apis dorsata*.
 Fig. 12. Showing the number to be nine in *Apis Adansonii*.
 Fig. 13. " " " eleven in *Apis nigro-cincta*.
 Fig. 14. " " " ten in *Apis indica*.
 Fig. 15. " " " ten in *Apis mellifica*.
 Fig. 16. " " " ten in *Apis florea*.

XXXVIII.—On *Raphides and other Crystals in Plants*.

By GEORGE GULLIVER, F.R.S.

[Continued from p. 212.]

Bromeliaceæ.—Besides the species of this order noticed in the 'Annals' for May last I have examined leaves of *Dasyllirion filiforme* and *D. acrostichum*, in which are a few raphides (more abundant in the pale bases of the leaves), crystal prisms, and sphæraphides; and a leaf of *Bonapartea gracilis*, which affords a profusion of raphides and a few larger crystal prisms.

Commelinaceæ.—To the former observations ('Annals,' June 1864) it may be added that *Tradescantia discolor* is also a raphis-bearing plant: a number of small quadratic crystals, or such octahedrons as were described in *Tradescantia* by Schleiden, I have likewise seen in the leaves and stem of *Tradescantia* and *Commelina*.

Araceæ.—Of the different tribes of this order in Prof. Balfour's 'Manual of Botany,' I have examined several species during last summer, and repeated and confirmed the observations given in the 'Annals' for May 1861, Sept. (page 228) and Nov. 1863,

Feb., March, and June 1864. The parts examined anew of the following plants will be noted within brackets.

Calla palustris: [leaf, flower-spike, spathe, and ovaries] all containing raphides. *Monstera deliciosa* [bits of leaves]: raphides abundant in large, hyaline, viscid cells; also some sphæraphides, especially in the petioles. *Arum maculatum* [leaves, berries, and tubers] and leaves and stem of *A. Dracunculus*: raphides abounding. *Colocasia odora*, *C. antiquorum*, and *Caladium viviparum* [leaves]: raphides plentiful in these three plants. Leaf, scape, and immature fruit of *Philodendron giganteum* and leaf of *P. pertusum*: raphides abundant. *Richardia æthiopica* [leaves]: raphides abundant, and affording a good example of biforines. *Diffenbachia maculata* [leaves] and leaf, flower-spike, and ovaries of *Orontium aquaticum*: abounding in raphides. Leaf of *Pothos acaulis*: raphides and starch plentiful. Leaf-blade and root of *Anthurium Harrisii*: a few small raphides and many cells containing small starch-granules. Leaf of *A. coriaceum*: small raphides and starch-cells, both scanty; many sphæraphides in the petiole. *Acorus Calamus* [leaves and root-stock] and leaves and flower-spike of *A. gramineus*: true raphides not seen in either of these plants; only (and that rarely) one or two solitary crystal-prisms and crystalline granules. *Typha latifolia* and *T. angustifolia* [leaves, stem, pith, and root-stock]: raphides rather plentiful. *Sparganium ramosum* and *S. simplex*: [leaves, stem, pith, peduncle, style, and outer green part of immature fruit] raphides in all these parts. *Lemna* [fronds]: all our species afford raphides, which are abundant in *L. minor* and *L. trisulca*, and comparatively scanty in *L. gibba* and *L. polyrrhiza*.

Thus, of all the plants yet examined of this order, *Acorus* is the only genus in which true raphides could not be found; and yet I have often searched for them in *A. Calamus* at all seasons, and when they were always easily found in such of the other plants as were available for comparison—to wit, *Arum*, *Typha*, *Sparganium*, and *Lemna*. The paucity of raphides in *Anthurium* appears remarkable when we consider their abundance in *Pothos* and *Orontium*.

Now our native plants above mentioned stand, in Prof. Babington's 'Manual of British Botany,' under the orders Typhaceæ, Araceæ, and Lemnaceæ, and between the orders Alismaceæ and Potamogetonaceæ. And while those species of the said three orders, Typhaceæ, Araceæ, and Lemnaceæ, with the single exception of *A. Calamus*, regularly afford raphides, the English species of the two neighbouring orders, Alismaceæ and Potamogetonaceæ, are as regularly devoid of raphides. But Prof. Lindley, in his admirable 'School Botany,' places *Acorus* in a distinct order, Acoraceæ, between Juncaceæ and Juncagi-

naceæ—two orders of which the British members are also destitute, or nearly so, of raphides.

Here, then, as far as regards the British Flora, are three orders differing, in the possession of this character of raphis-bearing, from their neighbouring orders; while, on the other hand, as we have already shown ('Annals,' March 1864, p. 214, and 'Quart. Journ. Micros. Science,' Jan. 1864), the order Hydrocharidaceæ differs, in the regular want of this character, from its neighbours Trilliaceæ, Dioscoreaceæ, and Orchidaceæ, three orders in which raphis-bearing is a constant and intrinsic, plain and certain function of the cell-life, if not of every species, certainly of all that I have examined.

Potamogetonaceæ to *Characeæ*.—We have already seen how abundant raphides are in many Endogens; but, although it is stated in some of our best and latest books of phytotomy that raphides abound in Monocotyledones generally, it is remarkable that I have never yet found true raphides in any native plant of the orders from *Potamogetonaceæ* to *Characeæ*, both inclusive, and which occupy a fifth part of the text in the 'Manual of British Botany.' Thus true raphides, after either an absence from or presence in several different preceding orders of Monocotyledones, are next so abundant in Typhaceæ, Araceæ, and Lemnaceæ, and at last suddenly cease to characterize any of the following orders, from *Potamogetonaceæ*, through the rest of the class, down to and inclusive of the Cryptogameæ Ductulosæ.

Edenbridge, April 3, 1865.

[To be continued.]

XXXIX.—*Contributions to an Insect Fauna of the Amazons Valley.* COLEOPTERA: LONGICORNES. By H. W. BATES, Esq.

[Continued from p. 225.]

- b.* Thorax widest at the basal angles, gradually narrowed thence to the apex.

11. *Colobothea pimplæa*, n. sp.

C. minus elongata et attenuata, cinereo- vel griseo-fulva; capite fusco, vertice lineis duabus divergentibus cinereo-fulvis; thorace vittis septem fuscis, quarum una mediana latiore; elytris griseis, fuscō irroratis, cinereo-fulvo maculatis, fasciis tribus (apud suturam interruptis) fuscis, apice sinuato-truncatis, angulis interioribus prominulis, exterioribus spiniformibus. Long. $4\frac{1}{2}$ –5 lin. ♂ ♀.

Head dingy brown, forehead streaked with tawny, vertex with two fine tawny lines diverging on the occiput. Antennæ black or reddish, fourth, sixth, eighth, and tenth joints with a whitish

ring. Thorax depressed at the base, ashy or tawny, with a broad central vitta, and, on each side, three narrower vittæ, purplish brown. Elytra moderately elongated, apex sinuate-truncate, with exterior angles produced into spines, and sutural angles dentiform; surface grey, minutely speckled with dusky and sprinkled with larger tawny (most often rounded) spots: each side has three transverse-quadrate purplish-brown spots or fasciæ, which do not reach the suture, the apex edged with tawny. Body beneath clothed with tawny-ashy pile; abdomen spotted on the sides with black. Legs reddish, spotted with ashy.

Terminal abdominal segment rather more tapering in the female than in the male; dorsal plate notched in both sexes; ventral plate terminating in spines in the male, angles simply acute in the female. Fore tarsi in the male moderately dilated, fringed with long hairs.

Branches of felled trees: Pará, Obydos, and banks of the Tapajos. Also found at Cayenne. I have seen it, in French collections, under the name of *C. sexlineata* (Reiche, MS.)—a name which I have not adopted, as the thorax has seven lines, and not six.

12. *Colobothea destituta*, n. sp.

C. minus elongata, obscure grisea; capite nigro, vertice lineis duabus divergentibus griseis; thorace vittis septem nigris, quarum una mediana latiore; elytris obscure griseis, nigro confertim irroratis, cinereo-griseo maculatis, fasciis interruptis tribus vel duabus (plus minusve obsoletis) nigris, apice sinuato-truncatis, angulis interioribus prominulis, exterioribus spiniformibus. Long. $4\frac{1}{2}$ –6 lin. ♂ ♀.

Head blackish, forehead streaked with ashy-grey, vertex with two fine ashy lines diverging on the occiput. Antennæ black, fourth, sixth, eighth, and tenth joints with a whitish ring. Thorax dull grey, with seven black vittæ, central one twice as thick as any of the rest. Elytra moderately elongated and tapering, apex sinuate-truncate, sutural angles dentiform, external spiniform; surface obscure grey, thickly irrorated with blackish, and having a few larger ashy, mostly rounded spots; each with two (and sometimes an indication of a third) transverse quadrate black spots, not distinctly limited. Body beneath ashy; abdomen spotted on the sides with black. Legs black, spotted with grey.

♂. Terminal ventral plate sinuate-truncate, angles acute; dorsal plate narrower, sinuate-truncate.

♀. Terminal abdominal segment elongated and tapering; both plates sinuate-truncate, not spinose.

On branches of dead trees, Pará.

13. *Colobothea seminalis*, n. sp.

C. minus elongata, fusco-nigra; capitis vertice lineis duabus diver-

gentibus; thorace vittis sex, elytris maculis parvis partim confluentibus, cinereo-fulvis, his apice cano marginatis sinuato-truncatis, angulis exterioribus spinosis. Long. $3\frac{3}{4}$ –5 lin. ♀.

Head blackish, forehead streaked with ashy-tawny, vertex with two ashy-tawny lines diverging on the occiput. Antennæ black or reddish, fourth, sixth, eighth, and tenth joints with a whitish ring at their bases. Thorax black, with three ashy-tawny longitudinal lines on each side; the sternum and the sides above the coxæ also tawny-ashy: on the surface near the base are two distinct punctures, besides the row along the hind margin. Elytra moderately elongated and tapering, deep brownish black, covered with little oblong tawny-ashy spots, which are collected together irregularly in some places, leaving small spaces of the ground-colour; the apex has a hoary spot. Body beneath tawny-ashy; abdomen spotted (as in the allied species) with black. Legs blackish, spotted with grey.

♀. Terminal ventral plate simply sinuate-truncate, angles not produced; dorsal plate narrower, emarginate at apex.

Branches of dead trees, Pará.

14. *Colobothea paulina*, n. sp.

C. robustior, modice elongata, fusco-nigra; capitis vertice lineis duabus divergentibus; thorace vittis sex, elytris maculis parvis oblongis discretis, cinereo-fulvis, apice cano marginatis, sinuato-truncatis, angulis exterioribus spinosis. Long. 4–6 lin. ♀.

Head dusky, streaked with ashy-tawny, vertex with two ashy-tawny lines diverging on the occiput. Thorax black, with three tawny-ashy lines on each side; the sides above the coxæ and the sternum of the same colour; surface wanting the two punctures near the base which are distinctive of *C. seminalis*. Elytra brownish black, sprinkled with a number of small oblong tawny-ashy spots, which are so arranged as to leave black undefined spaces in the situations where lateral spots or fasciæ are usually situated in the allied species; apex edged with hoary white. Body beneath ashy-tawny; abdomen spotted with black on the sides. Legs black, spotted with grey.

♀. Terminal ventral plate broadly emarginated at the apex, and with a tooth in the middle of the emargination; angles produced into spines. Dorsal plate tapering, obtuse.

Upper Amazons, at S. Paulo, on branches of dead trees. The species has also been found in the interior of French Guiana by M. Bar. A closely allied form is found in Venezuela; but it differs greatly in the shape of the terminal abdominal segment in the female*.

* *Colobothea mosaica* (Deyrolle, MS.). Modice elongata, nigra, griseo maculata. Caput nigrum, orbita oculorum griseo marginata. An-

15. *Colobotha varica*, n. sp.

C. modice elongata et attenuata, fusca; thorace dorso vittis duabus cinereo-fulvis, postice divaricatis, lateribus cinereo-fulvis vitta nigra; elytris maculis parvis cinereo-fulvis, partim discretis, partim subconfluentibus. Long. 4½–5 lin. ♂ ♀.

Head dusky, forehead streaked with tawny-ashy; two diverging lines of the same colour on the vertex. Antennæ black, reddish towards the base; fourth, sixth, eighth, and tenth joints with whitish rings. Thorax black on the surface, with two thickish tawny vittæ diverging behind; sides and under surface ashy, each with a black stripe. Elytra moderately tapering, apex truncate, exterior angles spinose; surface dark brownish, sprinkled with small tawny spots, sometimes arranged in rows over the basal half, but agglomerated more or less beyond the middle, leaving clear spaces; in other examples more irregular, apex edged with whitish. Body beneath somewhat uniformly clothed with tawny-ashy tomentum (except, as usual, the terminal segment). Legs reddish, spotted with ashy.

♂ ♀. Terminal abdominal segment tapering; dorsal plate rounded at tip; ventral broadly truncate, with angles produced into short and broad spines, and middle of the truncation slightly advanced or festooned. The fore tarsi in the ♂ are simple.

Branches of dead trees, Ega; abundant.

16. *Colobotha propinqua*, n. sp.

C. modice elongata et attenuata, fusca; thorace cinereo-fulvo, vittis septem fusco-nigris, una mediana et tribus utrinque lateralibus quarum duabus postice conjunctis tertiaeque inferiore tenuissima; elytris maculis parvis cinereo-fulvis in seriebus interruptis ordinatis. Long. 5 lin. ♀.

Head blackish, streaked with greyish; vertex with two divergent grey lines; antennæ black, reddish towards the base, fourth, sixth, eighth, and tenth joints ringed with white. Thorax ashy, with seven black vittæ—namely, one in the middle, broader, two on each side converging and blending before reaching the base, and one below them very slender. Elytra truncate at apex, with exterior angles spiniform; surface dark brown,

tennæ fuscae, griseo tomentosæ, articulis basi pallidioribus. Thorax griseus, vittis octo nigris, dorso punctis duobus prope basin. Elytra modice attenuata, apice truncata, angulis exterioribus spiniformibus, nigra, maculis quadratis griseis in seriebus sex vel septem ordinatis, pone medium et prope apicem interruptis. Corpus subtus cinereo-fulvo tomentosum, nigro maculatum. Pedes picei, cinereo tomentosi. Fœminæ segmento terminali abdominis attenuato, apice fisso. Long. 6 lin. *Hab.* in Venezuela. *Coll.* Bates.

covered with distinct ashy-tawny spots, arranged partly in rows, but interrupted by oblique clear spaces near the base, at the middle, and near the apex; apex with an ashy spot on each elytron, much enlarged towards the suture. Body beneath clothed with tawny-ashy tomentum; abdomen spotted with black. Legs reddish, spotted with black and ashy.

♀. Terminal ventral segment strongly tapering; ventral plate truncate, angles produced into lengthy spines; dorsal plate rounded at apex.

S. Paulo, Upper Amazons. It is very closely allied to *C. varica*, but differs in the thoracic markings from all the numerous specimens which I have examined of that species.

17. *Colobothea nævia*, n. sp.

C. elongata, nigra; thorace vittis quatuor tenuibus, elytris maculis parvis, rotundatis, dispersis, cinereis; corpore subtus vitta laterali fulvo-cinerea tomentosa infra nigro marginata. Long. $4\frac{1}{2}$ –6 lin. ♂ ♀.

Head black, streaked with tawny, vertex with two diverging lines of the same colour. Thorax black, with four tawny-ashy lines, the two dorsal ones not at all divergent. Elytra somewhat more elongated than in the preceding species; apex truncate, outer angles spinose; surface black, shining, and sprinkled with rounded tawny-ashy scattered spots, which sometimes leave a clear space behind the middle and near the apex; apex margined with whitish. Body beneath greyish; each side with a broad stripe of dense tawny tomentum extending from the front margin of the prothorax to the tip of the abdomen, interrupted on each segment of the latter by a black spot. Legs ashy, spotted with black.

♂. Terminal ventral segment elongated, flattened, tapering, very much longer than the dorsal, and deeply notched at the apex. Anterior tarsi not dilated, but fringed with long fine hairs.

♀. Terminal ventral segment tapering, apex sinuate-truncate, angles spinose; dorsal segment obtuse at apex, slightly notched in the middle.

On branches of dead trees, Ega. An abundant species.

18. *Colobothea juncea*, n. sp.

C. gracilior, angustata, fusca; thorace cinereo-fulvo, vittis septem fuscis; elytris pone humeros sensim, apices versus citius attenuatis, maculis parvis cinereo-fulvis plerumque confluentibus. Long. $4\frac{1}{2}$ lin. ♀.

Head blackish, streaked with ashy-tawny, vertex with two diverging tawny lines. Thorax ashy-tawny, with seven blackish vittæ. Elytra slender, tapering gradually from the shoulders to

near the apical spines, thence more quickly narrowed; apex truncate, outer angles spinose; surface sprinkled with ashy-tawny specks, agglomerated here and there into irregular larger spots, and leaving a clear space near the apex; apex broadly edged with white. Body beneath reddish, clothed with ashy tomentum, which is denser on the sides of the breast, and more scanty along the middle of the abdomen. Legs reddish, spotted with grey and black.

♀. Terminal abdominal segment tapering and narrow; ventral plate sinuate-truncate, angles not prominent; dorsal plate with a shallow angular emargination.

Pará.

19. *Colobotheca securifera*, n. sp.

C. modice elongata, postice attenuata, fusca; thorace vittis sex. cinereo-fulvis; elytris maculis parvis cinereo-fulvis conspersis, singulis spatio magno discoidali fusco maculam majorem cinereo-fulvam includente: maris segmento terminali ventrali angulis in lobos securiformes productis. Long. $4\frac{1}{2}$ lin. ♂ ♀. (7 exempl.)

Head reddish brown, streaked with tawny, and with two divergent tawny lines on the crown. Antennæ reddish, bases of alternate joints from the sixth ashy. Thorax chestnut-brown or dark brown, with six vittæ and the under surface ashy-tawny. Elytra rather short, tapering gradually and rather strongly from base to apex; apex sinuate-truncate, external angles spinose; surface dark castaneous brown or blackish brown, the basal and apical parts dusted with irregular-sized tawny-ashy specks, leaving a broad clear middle space, in the centre of which (on each elytron) is a large irregular tawny-ashy spot; apex with a triangular broadish ashy spot. Body beneath clothed with tawny-ashy pile. Legs reddish; tarsi and tibiæ spotted with ashy and black.

♂. Terminal ventral segment short and broad, each apical angle produced into a long, deflexed, horny, hatchet-shaped lobe; dorsal segment narrowed and emarginated at the apex: fore tarsi moderately dilated, not fringed; first joint not broader than the second.

♀. Terminal ventral segment tridentated, middle tooth shorter and broader than the outer ones; dorsal segment narrow and obtuse.

Pará and Lower Amazons.

20. *Colobotheca sejuncta*, n. sp.

C. modice elongata, postice attenuata, fusca; thorace vittis sex cinereo-fulvis; elytris maculis parvis cinereo-fulvis conspersis, singulis spatio magno discoidali fusco maculam majorem cinereo-

fulvam includente: maris segmento terminali ventrali obtuso, inermi, angulis penicillatis. Long. $4\frac{1}{2}$ lin. ♂ ♀. (3 exempl.)

Head reddish brown, streaked with tawny, and with two divergent tawny lines on the crown. Antennæ reddish, bases of alternate joints from the fourth or sixth ashy. Thorax chestnut-brown or darker, with six vittæ and the under surface ashy-tawny. Elytra rather short and slender, gradually and rather strongly tapering from base to apex; apex sinuate-truncate, both sutural and external angles spinose, the sutural shorter; surface dark castaneous brown, the basal and apical parts sprinkled with irregular-sized tawny-ashy specks, leaving a broad clear space on the disk of each, in the centre of which is a larger irregular tawny-ashy spot; apex with an ashy margin of regular width. Body beneath clothed with tawny-ashy pile. Legs reddish; tibiæ and tarsi spotted with ashy and black.

♂. Terminal abdominal segment rather elongate, thickened before the apex; the ventral plate with obtuse angles, from each of which proceeds a line of thick bristles; dorsal plate simple at the apex, and closely applied to the sloping front margin of the ventral. Fore tarsi with the first joint greatly dilated.

♀. Terminal abdominal segment strongly tapering and notched at the apex.

Ega, Upper Amazons.

The very great and striking difference in the accessory genital organs between these two closely allied species (*Colobothea securifera* and *C. sejuncta*) merits a few words of especial mention. When I was separating my specimens of *Colobothea* into species, I placed together all the individuals belonging to these two as one and the same, and could not find anything in their form or markings to warrant their being treated as anything more than mere local varieties, even after I had given them a second examination. A species has so often proved to exist under distinct local forms on the Upper and Lower Amazons, that I concluded this was simply another example of the rule. When I came, however, to separate the sexes previous to describing the species, I discovered the remarkable difference of structure described above, and then noticed the two or three other small points of difference in the general shape and tips of the elytra which I have noted in the descriptions. A pair of elongated horny processes, which I suppose to be the sheath of the penis, project from between the terminal abdominal segments in two out of the three males I possess; in the third they appear to be withdrawn into the abdomen. It is a remarkable circumstance, that in many families of Insects which have accessory sexual parts easy of examination, it is found that these differ very considerably in structure in closely allied species. It has been

remarked that they offer some of the best characters to distinguish species, and they have been made use of to separate species which scarcely offered any other distinguishable characters. Mr. Baly has also discovered that the horny penis concealed in the male abdomen of Phytophagous Coleoptera differs in form in closely allied species; and he has shown me a long series of specimens mounted for examination under the microscope, belonging chiefly to the genera *Chrysomela* and *Eumolpus*, which offer a most instructive study, since by their means some forms before considered as varieties turn out to be distinct species. This class of facts seems to me of great significance, as throwing light on the segregation of varieties and their passage into true species. For if we admit that the only sound difference between allied varieties and allied species is that the former intermarry, and the latter do not, then the abrupt and great diversities of structure in those organs most directly involved in the matter must be considered as affording an explanation why many varieties do not intercross with the parent stock, and therefore remain as independent forms or species. The difference in the accessory male organs of our two allied species or local forms of *Colobothea* is so great that no one who examines them can believe both to be adapted to the corresponding organs of the females of each form. At the same time I have no doubt that, were it not for the great difference between these organs in our two forms, no entomologist would doubt their being mere local varieties of one and the same stock. Scores of other local varieties occur in the same countries, presenting all the successive steps of segregation, from the most partial variation to the full-formed local race.

Thus we have only to admit that species disseminate themselves over wide areas, and adjust themselves to the diversities of local conditions, or, in other words, segregate local varieties, to open the way towards an explanation of the way in which the world has become peopled by its myriads of species. The inevitable law of Natural Selection which governs the general process of the adjustment of the local races to new conditions will explain the changes of conditions of life in time; and the laws of variation, diversified in details as are the species themselves, will explain the rest.

21. *Colobothea bisignata*, n. sp.

C. modice elongata, fusca; thorace vittis novem cinereis; elytris maculis parvis subconfluentibus cinereis, relicto spatio medio fusco maculam magnam albam includente. Long. 5 lin. ♂ ♀.

Head rusty brown, streaked with ashy, vertex with two ashy lines divergent towards the occiput. Antennæ rusty brown,

tips of joints blackish, bases of alternate joints whitish. Thorax with nine ashy longitudinal lines, the central one the slenderest, the second (from the central one) not reaching the hind margin, and the two lateral ones on each side very oblique. Elytra moderately short and tapering, apex sinuate-truncate, external angle produced into a long tooth; dark purplish brown, sprinkled near the base and apex with ashy dots, which unite here and there in irregular strigæ; the central space clear, and having in the middle of each elytron a large round white spot; there is also a small white spot on the suture near the scutellum. Body beneath clothed with dingy-ashy pile; abdomen spotted with black. Legs purplish brown, ringed with ashy.

♂ ♀. Terminal abdominal segment similar in form in the two sexes, longer and tapering in the female; the ventral plate in both truncated, with angles simply acute; the dorsal plate distinctly notched in the middle of its apex in the female, obtuse in the male. Tarsi simple in the male.

A common insect on dead branches, &c., at Ega.

22. *Colobothea latevittata*, n. sp.

C. elongata, angustior; thorace sordide fulvo-cinereo, vitta lata mediana alteraque tenui laterali fuscis; elytris postice attenuatis, humeris valde obliquis, fuscis, maculis fulvo- vel sordide cinereis plagiatis conspersis. Long. 4-5 lin. ♂ ♀.

Head blackish, streaked with tawny, vertex with a single tawny line extending to the occiput. Antennæ long and slender, dusky brownish at the tips and ashy at the bases of the joints. Thorax with a small acute prominence on each side near the base; clothed with dingy tawny or ashy tomentum, leaving a broad stripe in the middle and a slender line on each side of the disk dark brown. Elytra rather slender and tapering; shoulders very oblique, apex somewhat narrow and sinuate-truncate, with sutural angle slightly prominent, external dentiform; surface brown, covered with dingy ashy or tawny spots, which unite together in patches, leaving irregular brown spaces. Body beneath dingy tawny; abdomen not spotted with black on the sides. Legs rusty brown, varied with black, and ringed with ashy.

♂. Anterior tarsi dilated and fringed. Terminal abdominal segment short, truncated; ventral plate emarginated at the apex.

♀. Terminal abdominal segment greatly elongated and sub-tubular; dorsal plate slender, obtuse; ventral truncated, angles not produced.

Var. *Obydensis*. A female example in my collection from Obydos, on the Guiana side of the Lower Amazons, differs from

the typical form in having a distinct quadrate silky-brown spot on each elytron close to the apex, and also a distinct broad dusky stripe along the episterna of the prothorax.

Taken at Carepí, near Pará; found also, but sparingly, at Santarem and at Ega.

23. *Colobothea styligera*, n. sp.

C. elongata, thorace fulvo-cinereo, vitta lata mediana alteraque tenui laterali velutino-nigris, lateribus infra cinereo-fusco late vittatis; elytris postice attenuatis, cinereo-fulvo dense confluentes maculatis, relictis utrinque macula rotundata pone medium alteraque quadrate apicali nigro-fuscis. Long. 6 lin. ♂ ♀.

Head blackish, streaked with tawny; vertex with a single tawny line. Antennæ blackish, bases of fourth to sixth joints white. Thorax with the posterior angles extending laterally towards the shoulders of the elytra, above tawny fulvous, with a broad velvety-black central vitta, and a narrow lateral line of the same colour. The episterna have a broad ashy-brown stripe. Elytra tapering, shoulders less oblique, densely clothed with confluent ashy-tawny spots, leaving a rounded discoidal spot on each behind the middle, and a quadrate one close to the apex, dark brown; apex sinuate-truncate, sutural angle slightly prominent, external dentiform. Body beneath ashy, varied with tawny patches; abdomen spotted with dusky. Legs tawny-ashy, spotted with black.

♂. Anterior tarsi dilated and fringed. Terminal abdominal segment not reaching the tip of the elytra, narrowed towards the apex; dorsal plate obtuse, ventral truncate-emarginate.

♀. Terminal abdominal segment tubular, prolonged considerably beyond the apex of the elytra; dorsal plate lanceolate, ventral truncated, angles not produced.

Ega.

24. *Colobothea grallatrix*, n. sp.

C. elongata, postice valde regulariter attenuata, nigra; thorace vittis sex cinereo-fulvis, lineolaque mediana cinerea; elytris cinereo fulvoque dense confluentes irroratis, maculis tribus utrinque discoidalibus plagaque magna apicali nigris; maris pedibus longissimis validis. Long. ♂ $6\frac{1}{2}$, ♀ $4\frac{1}{2}$ lin.

Head blackish, streaked with tawny, vertex with two tawny-ashy slightly divergent lines. Antennæ robust, black, bases of alternate joints ringed with whitish. Thorax black, and having on each side three tawny-ashy vittæ, and a thin grey line down the middle of the black central streak. Elytra with shoulders moderately prominent laterally and vertically, thence regularly tapering to the apex, which is truncated, with the sutural angle moderately produced, and the apical angle spiniform; the surface is thickly covered with confluent spots, partly grey and

partly fulvous, which leave, on the disk of each, three spots (one before the middle, and two, placed obliquely, after the middle) and a large square black apical spot of a fine black colour; apex margined with ashy. Body beneath grey; sides, from the front of the prothorax to the penultimate ventral segment, occupied by a broad ochreous-tawny stripe; sides of abdomen spotted with black. Legs ashy, spotted with black.

♂. Legs greatly elongated, and stouter than in the female; anterior tarsi broadly dilated and hirsute. Terminal abdominal segment short; apex both of the dorsal and ventral plates emarginated.

♀. Terminal abdominal segment narrow and moderately elongated, obtuse, angles not produced.

Ega and S. Paulo; rare.

25. *Colobothea olivencia*, n. sp.

C. elongata, postice regulariter attenuata, nigra; thorace vittis quatuor cinereo-fulvis; elytris confluentur fulvo-cinereo maculatis, plaga quadrata apicali nigra. Long. $5\frac{1}{2}$ – $6\frac{1}{2}$ lin. ♂ ♀.

Head blackish, streaked with tawny, vertex with two divergent tawny-ashy lines. Antennæ black, fourth, sixth, and tenth joints white at the base. Thorax black; disk with two tawny-ashy vittæ continuous with the lines on the crown of the head, and, like them, divergent posteriorly; besides these, there is a narrower vitta on each side at the extreme edge of the pronotum, and scarcely visible from above. Elytra with a prominent black tubercle at the apex of the prominent shoulders, gradually tapering, apex truncate, sutural angles scarcely prominent, external spiniform; surface sprinkled with tawny (and a few grey) spots, which are confluent, but do not leave very distinct black spaces; close to the apex, on each, is a large square black patch, the apex itself being edged with whitish. Body beneath ashy-tawny; breast, and abdomen on the sides, streaked or spotted with black. Legs varied with ashy and black.

♂. Larger and more robust than the female, both in body and limbs; anterior tarsi dilated and fringed. Terminal abdominal segment short, apex of both the dorsal and ventral plates emarginated.

♀. Terminal abdominal segment elongated, and projecting beyond the apex of the elytra, but not tubular, and somewhat flattened, with the apex both of the dorsal and ventral plates truncated and notched in the middle.

S. Paulo, Upper Amazons; rare.

26. *Colobothea pura*, n. sp.

C. elongata, postice attenuata, nigra; thorace vittis quatuor elytris-

que maculis confluentibus cinereo-fulvis, his spatio apicali nigro; antennis robustissimis (♂), nigris, articulo sexto annulo lato albo, 8^{vo} et 10^{mo} basi cinereis. Long. $5\frac{1}{2}$ – $6\frac{1}{2}$ lin. ♂.

Head black, with ashy lines, vertex with two divergent tawny-ashy lines. Antennæ (♂) extremely stout, gradually tapering to the apex, deep black; the joints from the base to the sixth spotless; the sixth has a white ring occupying two-thirds of the length of the joint; the base of the eighth joint is grey (on one side only), and the tenth joint has an ashy ring. Thorax deep black, the central part with two ashy-tawny vittæ not continuous with the lines of the crown, and parallel; the sides near the episternum have also each a tawny-ashy line. Elytra tapering in straight lines to the apex, the latter truncated, with sutural angle not produced, external dentiform; surface thinly and irregularly sprinkled with punctures, each of which has a very short strong bristle, and being surmounted by a granule; olivaceous-black, sprinkled with ashy or tawny-ashy specks, everywhere confluent and forming a marbled pattern, but leaving a black space near the apex; apex itself edged with ashy. Body beneath grey, varied with tawny, and having, in fresh examples, a tawny-ochreous lateral vitta from the front edge of the prothorax to the last segment of the abdomen; abdomen thinly clothed with grey pile, sides spotted with black. Legs black, thinly clothed with grey pile; knees and tips of tibiæ and tarsi black.

♂. Legs elongated and robust; anterior tarsi dilated and fringed. Terminal ventral segment semicircularly sinuated at the apex, with the angles acute and produced; dorsal plate broad, obtuse, faintly emarginated.

Obydos, Lower Amazons.

27. *Colobotha carneola*, n. sp.

C. elongata, postice modice attenuata, nigra; thorace vittis quatuor, elytrisque maculis numerosis discretis, carneo-fulvis, his spatio apicali nigro; antennis (♂) normalibus, articulis 4^{to}, 6^{to}, 8^{vo}, 10^{mo} albo annulatis. Long. $5\frac{3}{4}$ lin. ♂.

Very closely allied to *C. pura*, but differs in the degree of robustness and coloration of the antennæ, and in the spots on the elytra being nearly all quite separate and inclining in colour towards pinkish red. The elytra are sprinkled with punctures, as in *C. pura*, but they are not so conspicuous, nor surmounted by elevated points; the bristles are more numerous towards the apex, although the punctures from which they arise are not conspicuous. Body beneath and legs as in *C. pura*.

♂. Terminal ventral segment semicircularly sinuated at the

apex, with the angles acute; dorsal obtusely truncated. Anterior tarsi dilated and fringed.

Obydos.

28. *Colobotheca forcipata*, n. sp.

C. gracilis, postice valde attenuata, nigra, vertice thoraceque vitta lata communi cinerea; elytris cinereo nebulosis, relictis plagis lateralibus et vitta lata apicali nigris; antennis nigris, articulo 6^{to} albo annulato; maris segmento ventrali terminali forcipato. Long. 4-5½ lin. ♂.

Head black, forehead spotless, vertex with a broadish ashy line, which continues along the middle of the thorax, enlarging posteriorly, the rest of the surface of the thorax deep black. Antennæ black, sixth joint alone marked with a white ring. Elytra gradually attenuated from base to apex, the latter sinuate-truncate, sutural angle prominent, external spiniform; surface punctured, setose, and marked with an ashy cloud extending from the scutellum to near the apex, and emitting several irregular branches; the apical part is crossed by a broad black vitta, the apex itself being edged, as usual, with white. Body beneath ashy; sides of thorax and abdomen with a broad yellowish vitta. Legs ashy, spotted with black.

♂. Terminal ventral segment with each side produced into a long, compressed, incurved, horny lobe, the apex of which is obliquely truncated; dorsal plate obtusely rounded at apex.

Ega, rare.

[To be continued.]

XI.—*Diagnoses of new Forms of Mollusca from the West Coast of North America, first collected by Col. E. Jewett.* By PHILIP P. CARPENTER, B.A., Ph.D.

[Concluded from p. 182.]

Mangelia variegata.

M. testa valde attenuata, tenui, parva, pallide carnea, rufo-fusco normaliter bizonata, interdum unizonata, seu zonis interruptis; vertice nucleoso conspicuo, anfr. uno et dimidio, apice mamillato; anfr. norm. vi., subrotundatis, suturis valde impressis; costis radiantibus ix., angustis; costulis spiralibus crebris, validioribus, in spira circ. x., costas superantibus; apertura valde elongata; canali brevi, aperto; labro tenui, juxta suturam conspicue arcuato; labio tenui. Long. .31, long. spir. .17, lat. .1 poll., div. 22°.

Variat costis crebrioribus, sculptura minus expressa.

Hab. Sta. Barbara (Jewett).

Mangelia (? *variegata*, var.) *nitens*.

M. testa *M. variegatae* simili, sed nitentiore, fascia alba et altera

rufo-fusca attingente spiram ascendentibus. Long. .25, long. spir. .15, lat. .08, div. 20°.

Hab. Sta. Barbara (*Jewett*), rare.

Mangelia angulata.

M. testa parva, rufo-purpurea, vix gracili, epidermide tenui fugaci; anfr. nucl. iii., helicoideis, primum lævibus, dein cancellatis, apice mamillato; anfr. norm. iv., convexis, suturis impressis, in medio spiræ obtusangulatis; costis radiantibus circ. xii., acutioribus; costula spirali circa angulum, inter costas subobsoleta; tota superficie tenuiter spiraliter crebrisulcata, sulculis sub lente sæpius bifidis; apertura pyriformi, canali longiore, recto, aperto; labro acuto, postice conspicue sinuato; columella haud contorta; labro obsoleto. Long. .35, long. spir. .18, lat. .13, div. 30°.

Hab. Sta. Barbara (*Jewett*).

Myurella simplex.

M. testa rufo-cinerea, minore, minus tereti, epidermide tenui; anfr. xii., planatis; fascia suturali valida, nodosa, tuberculis ovalibus crebris validioribus (anfr. penult. circa xv.) ornata; testa adolescente costulis radiantibus, postea evanescentibus; striolis antice et postice spiralibus, circa peripheriam sæpe obsoletis; basi rotundata; canali brevissimo, alte emarginato; carina supra canalem acuta, columellam plicante; labro acuto, vix undato. Long. 1.03, long. spir. .76, lat. .27, div. 20°.

Variat tuberculis subobsoletis.

Hab. Sta. Barbara (*Jewett*); S. Pedro (*Cooper*).

Odostomia inflata.

O. testa majore, tenui, pallide cinerea, epidermide cinerea induta; vert. nucl. subito immerso; anfr. norm. iv., rapidissime augmentibus, subplanatis, suturis impressis; tota superficie minutissime et confertissime spiraliter striolata; umbilico nullo; basi et apertura valde elongatis; labro acuto; labio tenuissimo; plica acuta, transversa, parietem attingente; columella valde arcuata, antice effusa. Long. .26, long. spir. .09, lat. .14, div. 60°.

Variat spira elatiore. Long. .24, long. spir. .11, lat. .13, div. 45°.

Variat quoque striolis subobsoletis.

Hab. Sta. Barbara (*Jewett*); Farraleone Islands, in cavities, on *Haliotis* (teste R. D. Darbishire); near San Francisco (*Rowell*); Neeah Bay (*Swan*).

Chemnitzia crebrifilata.

C. testa satis tereti, subalbida, haud regulari; anfr. nucl. ii., helicoideis, decliviter sitis, margines spiræ parum excurvatos paullum superantibus; norm. viii., quorum primi subrotundati, ultimi vix planati; suturis valde distinctis; cost. rad. circ. xxiv., subrectis, acutioribus, angustis, interdum attingentibus, anfr. ultimo cre-

brioribus minus expressis, circa basim prolongatam haud subito evanescentibus; lirulis spiralibus, in spira circ. viii., rotundatis, expressis, anfr. ult. supra costas subnodulosis, circa basim crebrioribus; peritremate continuo; columella vix torta, haud plicata; labio distincto. Long. .22, long. spir. .17, lat. .07, div. 18°.

Hab. Sta. Barbara, 1 specimen (*Jewett*).

403 b. *Chemnitzia* (?*torquata*, var.) *stylina*.

C. testa C. torquatae simili, sed valde teretiore, gracillima, interdum subdiaphana; anfr. nucl. ii., decliviter sitis, margines spiræ fere parallelas vix superantibus; norm. xii., angustis, subplanatis, suturis distinctis; costis radiantibus circ. xxiii., latis, declivibus, testa juniore continuis, adulta fascia haud sculpta suprasuturali separatis; interstitiis parvis, haud sculptis; basi rotundata, haud sculpta; columella parum torta. Long. .32, long. spir. .27, lat. .8, div. 10°.

Hab. Sta. Barbara (*Jewett*); Monterey (*Cooper*).

Chemnitzia Virgo.

C. testa parva, alba, gracili, stylina; anfr. nucl. ii., decliviter sitis, margines spiræ subparallelas haud superantibus; norm. viii., subrotundatis, suturis distinctis; costulis radiantibus circ. xviii., angustis, acutioribus, sæpe attingentibus, circa peripheriam haud subito evanidis, interstitiis subæqualibus alte spiraliter sulcatis, sulcis circ. viii., latera costarum crenulantibus, costas haud superantibus; basi valde rotundata, curta, haud sculpta; axi lacunato; peritremate vix continuo; columella recta. Long. .18, long. spir. .14, lat. .05, div. 12°.

Hab. "Sta. Barbara," 1 specimen (*Jewett*).

Dunkeria laminata.

D. testa satis elevata, rufo-fusca, fasciis pallidioribus interdum cincta; anfr. nucl. ii., helicoideis, valde decliviter sitis, margines spiræ subrectos haud superantibus; norm. viii., subrotundatis, suturis impressis; costis spiralibus rotundatis, in spira iv., aliisque suturalibus vix rotundatis, interstitiis minoribus impressis; super eas laminis radiantibus acutioribus circ. xxx., circa basim rotundatam tenuiter continuis; liris spiralibus basalibus circ. viii., obtusis, columellam versus subflexuosam obsoletis; peritremate continuo; labio appresso. Long. .25, long. spir. .18, lat. .07, div. 20°.

Hab. Sta. Barbara (*Jewett*); San Diego (*Cooper*).

This beautiful Fenelloid species may be regarded as the type of the group *Dunkeria*.

Eulima Thersites.

E. testa parva, curtissima, albida, arcuata, valde distorta; marginibus spiræ dextro subrecto, sinistro valde excurvato; anfr. nucl. ?.. (decollatis); norm. vi., lævibus, subplanatis, suturis distinctis; basi valde arcuata; apertura subovali, dextrorsum producta; peri-

tremate continuo, valde calloso; labro sinuato. Long. .21, long. spir. .13, lat. .09, div. 40°.

Hab. Sta. Barbara, 1 specimen (*Jewett*).

Preeminent for aberration among the distorted Eulimidæ. A second specimen occurred from an uncertain source.

Opalia bullata.

O. testa minore, alba, subdiaphana, turrita, gracili; marginibus spiræ subrectis; tota superficie minutissime et creberrime spiraliter striolata; vertice nucleoso declivi, celato; dein anfr. ii., globosis, radiatim haud sculptis; dein v. normalibus, planatis, suturis vix impressis; lirulis radiantibus circ. xxvi., haud nisi in anfr. primis expressis, circa basim irregulariter rotundatam ad axim continuis; serie bullularum suturalium anfr. primis e lirulis extantibus formata, postea lirulis haud convenientibus, anfr. penult. circ. xvii., planatis, super suturas parieti appressis, interstitiis haud infossis; basi subangulata, haud costata; apertura subovali, sinistrorsum subplanata; peritremate continuo, calloso; labro haud sinuato. Long. .3, long. spir. .21, lat. .09, div. 20°.

Hab. Sta. Barbara, one specimen (*Jewett*).

422. *Cerithiopsis purpurea.*

C. testa compacta, haud gracili, marginibus spiræ parum excurvatis; purpurea seu fusco-purpurea, circa peripheriam pallidiore; anfr. nucl. ? ii., lævibus; norm. vii., planatis, suturis impressis; seriebus iii. nodulorum minorum supra costulas spirales minores, ad intersectiones costularum radiantium circ. xxiii., lineis fere rectis, ad suturas interruptis, spiram ascendentium sitis; interstitiis impressis, quadratis; costulis suturalibus ii. haud nodulosis; basi rotundata, antice lirulis paucis expressis inter eas et costulas suturales vix sculpta; apertura subquadrata; columella torta, emarginata. Long. .29, long. spir. .19, lat. .1, div. 20°.

Hab. Sta. Barbara (*Jewett*); Monterey, San Diego (*Cooper*).

423. *Cerithiopsis fortior.*

C. testa *C. purpureæ* simili, sed sculptura multo fortiore, basi pallida; seriebus nodulorum spiralibus testa adolescente ii., postea iii.; costis radiantibus circ. xiii., interstitiis magnis; costis suturalibus validis, subnodosis; costa basali valida. Long. .3, long. spir. .2, lat. .11, div. 26°.

Hab. Sta. Barbara, 1 specimen (*Jewett*).

439. *Marginella subtrigona.*

M. testa *M. Jewettii* simili, sed multo curtior, latior; antice valde angustata, postice valde tumente; labro postice minus prolongato; plicis iv., validioribus, parietali una. Long. .14, long. spir. .01, lat. .11, div. 130°.

Hab. Sta. Barbara (*Jewett*).

440. *Marginella regularis*.

M. testa M. Jewettii simili, sed multo minore, paullum angustiore; tenui, nitidissima, crystallina, omnino diaphana; labio magis calloso. Long. .13, long. spir. .01, lat. .09, div. 120°.

Hab. Sta. Barbara (*Jewett*); coast of California south from Monterey, beach to 20 fathoms; Catalina Island, 10–20 fathoms, State Coll. no. 398 *a* (*Cooper*).

453. *Amycla tuberosa*.

A. testa A. minori simillima, sed vertice nucleoso tuberoso; anfr. iv., tumidis, rapide augmentibus; apice minimo, margines spiræ rectos parum superante, interdum subdecliviter sito; testa adulta interdum unicolore, livida seu aurantiaca; plerumque albida, rufo-fusco varie picta, seu maculata, seu nebulosa, seu strigata strigis radiantibus seu flexuosis, seu varie penicillata, sæpe fascia tessellata subsuturali; anfract. norm. v., planatis, suturis distinctis; basi subangulata; apertura pyriformi, canali satis prolongato, arcuato; labro intus acuto, deorsum quasi tumidiore, postice sinuato, intus circ. octodentato; labio parum conspicuo, vix rugulato; columella torta, axi antice striato; superficie lævi, seu interdum minutissime sub lente radiatim striolata; epidermide cornea, tenui, subdiaphana, spiraliter sub lente minutissime striolata: operculo Nassæformi, parvo, marginibus irregulariter serratis, cicatrice bilobata. Long. .32, long. spir. .18, lat. .14, div. 30°.

Hab. Sta. Barbara, recent and fossil (*Jewett*); coast of California north to Monterey; Catalina Island, 8–10 fathoms (*Cooper*).

As this belongs to a group of closely allied species of Nassoid Columbellæ, a minute diagnosis is given. The fossil specimens are larger, and have the remarkable nucleus more perfect, than any of the recent shells yet seen. In appearance it scarcely differs from the small variety of the Mediterranean *A. minor*, Scac.; but that (with *A. corniculata*) has a Chrysodomoid nucleus, the Californian an Alaboid.

? *Anachis penicillata*.

?*A. testa* parva, Metuloidea, turrita, albida, rufo-fusco plus minusve penicillata; anfr. nucleosis ii., tumidis, helicoideis, apice mamillato; norm. vi., tumidis, suturis valde impressis; costis radiantibus circ. xii., angustis, expressis; lirulis spiralibus extantibus, in spira plerumque vi. supra costas transeuntibus; apertura pyriformi, antice effusa; labro postice sinuato. Long. .21, long. spir. .13, lat. .08, div. 25°.

Hab. Sta. Barbara (*Jewett*); S. Diego, Catalina Island, shore to 10 fathoms (*Cooper*).

Neither of the specimens sent is quite mature. The mouth is that of an adolescent *Anachis*, but the sculpture is Metuloid.

Siphonalia fuscotincta.

S. testa minima, turrita, albida, apicem versus fusco tincta; anfr. nucl. ii., compactis, subplanatis, apice mamillato; norm. iv., convexis, suturis impressis; costis radiantibus rotundatis, tumentibus, basim versus evanidis, interstitiis undulatis, subæquantibus; lirulis crebris spiralibus, costas superantibus; apertura pyriformi, in canalem brevem apertum contortum producta; labro acuto; labio haud conspicuo; columella canalem versus valde contorta. Long. .17, long. spir. .1, lat. .08, div. 32°.

Hab. Sta. Barbara (*Jewett*).

The unique specimen is like a minute edition of *Siphonalia Kelletii*, but does not accord with the young of that or of any other species known in the region. It is probably not mature.

XLI.—*Diagnoses of new Forms of Mollusca collected by Col. E. Jewett on the West Tropical Shores of North America.* By PHILIP P. CARPENTER, B.A., Ph.D.

Rissoina expansa.

R. testa magna, lata, tenuisculpta, alba, nitente, subdiaphana; marginibus spiræ parum excurvatis; anfr. nucl. lævibus, vertice mamillato; norm. v., planatis, suturis distinctis; costulis radiantibus circ. xxiv., obtusis, haud extantibus, interstitia æquantibus, peripheriam versus evanidis; circa basim productam striis spiralibus expressis; medio lævi; apertura valde expansa, semilunata; labro subantice producto, varicoso, antice et postice alte sinuato; labio calloso. Long. .35, long. spir. .18, lat. .17 poll., div. 30°.

Hab. Mazatlan (teste *Jewett*).

This fine species is the largest known in the fauna. It most resembles *R. infrequens*, C. B. Ad., which was described from a dead shell.

Mangelia hamata.

M. testa carneo-aurantiaca, satis turrita, marginibus spiræ excurvatis; anfr. nucl. ii. globosis, tenuissime cancellatis, apice mamillato; norm. vi., subelongatis, in spira tumentibus, subangulatis, suturis impressis; costis radiantibus x.-xii., acutioribus, validis, circa basim prolongatam continuis; interstitiis concavis; lirulis spiralibus filosis, distantibus, supra costas transeuntibus, in spira iii.-iv.; apertura subelongata, quasi hamata, intus lævi, intense colorata; labro acuto, dorsaliter varicoso, postice valde sinuato. Long. .24, long. spir. .13, lat. .1, div. 25°.

Hab. Panama (teste *Jewett*).

This very beautiful species is easily recognized by the varicose lip, sloping off to a sharp edge; by the deeply cut posterior notch, giving the smooth mouth a hooked appearance; by the

sharp ridges, traversed by distant spiral threads; and by the flesh-tinted orange colour.

Mangelia cerea.

M. testa M. hamata simili, sed textura cerea, aurantiaca, graciliore, anfractibus tumidioribus, haud angulatis; anfr. nucl. lævibus; normalibus v., costis radiantibus haud acutis, interstitia æquantibus; liris spiralibus validioribus, haud filosis, supra costas nodulosis, in interstitiis subobsoletis; apertura, testa adulta, ?.... Long. .25, long. spir. .14, lat. .1, div. 28°.

Variat testa rufo-fusca.

Hab. Panama (teste Jewett).

Col. Jewett's unique specimen is not mature. It is distinguished from *M. hamata* by the smooth nucleus, waxen texture, rounder whorls, more equal distribution of the contour between ribs and interstices, and especially by the spiral sculpture, which is faint in the hollows, but nodulose on the ribs. Mr. Cuming has a specimen with the same texture, but of a rich brown colour.

Chemnitzia cælata.

C. testa satis magna, cinerea, elongata; anfr. nucl. ?...; norm. xiii., planatis, suturis vix impressis; costis radiantibus xx.-xxviii., rectis, haud semper convenientibus, subacutis, ad peripheriam subito truncatis; sulcis spiralibus in spira iv.-v., valde impressis, interstitia et costarum latera transeuntibus, juga haud superantibus; basi subito angustata, angulata, lirulis spiralibus circ. vi. ornata; apertura subquadrata; columella satis torta. Long. .35, long. spir. .3, lat. .09, div. 13°.

Hab. West coast of North America (Jewett).

This beautiful and unique shell was probably from Panama; but there was no locality-mark. It is remarkable for its deep furrows and the suddenly shortened and spirally sculptured base. It is much larger and broader than the northern *C. Virgo*, and differs in details of sculpture.

XLII.—*Notices of British Fungi*. By the Rev. M. J. BERKELEY, M.A., F.L.S., and C. E. BROOME, Esq.

[Continued from p. 322.]

1038. *Ptychogaster albus*, Cd. fasc. 2. fig. 90.

On the ground, at the roots of firs. Aboyne, Aberdeenshire; Staunton, Notts. It has also been found near London by Mrs. Lloyd Wynne.

The affinities of this curious plant are very doubtful; for it does not appear to be of the creamy consistence of *Æthidium* in any stage of growth. We have no better opinion, however, to

give than that of Corda. Fries seems to think that it is a degeneration of *Polyporus destructor*.

1039. *Nidularia pisiformis*, Tul. Ann. d. Sc. Nat. 3 sér. vol. i. p. 100; Curr. l. c. figs. 5, 6, 22.

On pine chips. St. George's Hill, Weybridge, May and Oct., F. Currey.

This is *Granularia pisiformis*, Roth, a species which Mr. Currey has happily rescued from oblivion.

**Sphaeropsis pinea* (*Sphaeria pinea*, Desm. no. 1277).

On pine branches, F. Currey.

1040. *Dilophospora graminis*, Desm. no. 1091.

On *Alopecurus agrestis*, Mr. Currey.

In Sussex it was very destructive to a wheat crop in 1862, causing the ears to swell in a very curious manner, and to turn, in parts, of a jet-black.

1041. *Speira toruloides*, Cd. fasc. 1. fig. 140.

On dead herbaceous plants. Batheaston, C. E. Broome, 1864.

1042. *Sporidesmium abruptum*, n. sp. Pulvinatum, stipitibus brevissimis cum sporis oblongis septatis confluentibus; articulis inæqualibus.

On dead wood. Bodelwyddan, March 1864. Sent by Mr. Bloxam from Twycross.

Forming little pulvinate tufts externally resembling a villous *Sphaeria*. Spores oblongo-clavate, confluent with the stem, septate; the lower articulation and the uppermost short, the second from the top very long. Spores $\cdot 0025$ inch long, $\cdot 0006$ inch wide.

PLATE XIV. fig. 8. Group of spores in various stages of growth, magnified.

1043. *Acalyptospora nervisequia*, Desm. Ann. d. Sc. Nat. 1848, vol. x. p. 343.

On living and dead leaves of elm. Apethorpe, Norths., 1857.

Looking like a short obtuse *Puccinia*, with one to three septa and a short pellucid stem. In every stage of growth free. It closely resembles a gland.

1044. *Puccinia noli-tangeris*, Cord. fasc. 4. fig. 57.

On *Impatiens fulva*. Albury, Surrey, Rev. L. Jenyns.

1045. *Uredo Padi*, Schmidt & Kze., no. 187.

On leaves of *Prunus Padus*. Aboyne, Aberdeenshire.

Sori minute, seated on a purple spot. Spores $\cdot 0006$ – $\cdot 0007$ inch long.

1046. *Trichobasis Parnassiae*, Cooke, Micr. Fung. p. 106.

On leaves of *Parnassia palustris*. Irstead Marshes, 1864.

1047. *Lecythea Poterii*, Lév. Dict. Univ. d'Hist. Nat. vol. xii. p. 786.

On leaves of *Poterium Sanguisorba*, M. C. Cooke.

1048. *Æcidium Thesii*, Desv. Journ. de Bot. ii. p. 311.

On leaves of the common *Thesium*. Hildersham, Cambridge, Rev. J. E. Leefe, May 11, 1841. Near Winchester, M. C. Cooke, 1864.

1049. *Graphiola Phœnicis*, Poiteau, Ann. des Sc. Nat. 1824, p. 473.

In the Sheffield Botanic Garden, on the Date-Palm, Sept. 5, 1861, Mr. J. Henderson.

1050. *Isaria felina*, Fr. Syst. Myc. vol. i. p. 496.

On cats' dung, near London, M. C. Cooke, Jan. 1864. Mixed with *Mucor Phycomyces*.

1051. *Fusarium heteronema*, n. s. Floccis deorsum septatis articulis amplis, sursum inarticulatis ramosis sæpe furcatis gracilibus; sporis oblongis, curvulis, uniseptatis.

On decaying pears. Batheaston, C. E. Broome, Oct. 12, 1863.

Resembling somewhat *Septosporium curvatum*, Caspary, a species which grows on the leaves of *Robinia*, but not really very closely allied. This species is sometimes accompanied by the common orange *Fusarium*, which is known at once by its very different spores.

PLATE XIV. fig. 9. Threads with spores magnified.

1052. *Helminthosporium scolecoides*, Cd. fasc. i. fig. 179.

On dead stems of some herbaceous plant. Twycross, Rev. A. Bloxam.

1053. *H. rhabdiferum*, Berk. in Gard. Chron. 1864, p. 938.

On ripe peaches. Bodelwyddan, Flintshire, Sept. 1864.

**Tripodosporium elegans*, Cd. fasc. 1. fig. 220.

This curious production sometimes occurs with globose spores at the tips of one or more of the three terminal processes, as seen by Mr. Broome, of which we think it well to give a figure, whether the plant be considered autonomous or not.

PLATE XIV. fig. 10. *a.* thread having three globose bodies or spores; *b b.* the tips and bodies more highly magnified.

1054. *Gonytrichum fuscum*, Cd. fasc. 1. fig. 160.

On dead sticks. Batheaston, C. E. Broome.

1055. *Acrothecium delicatulum*, n. s. Effusum, nigrum; floccis strictis; sporis linearibus, uni- vel pluri-septatis, hyalinis.

On dead wood, probably beech. King's Cliffe.

The spores are confined to the upper part of the stem, but not to the apex itself. Occasionally the flocci are forked. Spores .00045–.0007 inch long.

A form occurs with scattered flocci, on bramble, at Batheaston, but differing in no other respect.

PLATE XIV. fig. 11. *a.* flocci with spores magnified; *b.* spores more highly magnified.

1056. *Edocephalum laticolor*, n. s. Minutissima, lateritia; stipite æquali, pallido; capitulo subgloboso; sporis globosis, granulatis, appendiculatis.

On sheeps' dung. Batheaston, Oct. 1863.

Not half a line high, sending out at the base a few threads into the matrix; before the head is formed, nearly cylindrical, with some large oil-globules, which at length in great measure vanish. Spores ·0006–·0008 inch in diameter, with a little appendage at the base like those of *Epicoccum*.

Three species of *Edocephalum* are figured in No. 35, vol. vi. of St. Deutschl. Fl.

PLATE XIV. fig. 12. *a.* flocci and heads magnified; *b.* ditto, more highly magnified; *c.* portion of head with young spores, ditto; *d.* mature spores, ditto.

1057. *Peronospora sparsa*, B. in Gardeners' Chronicle, 1862, p. 308.

On rose-leaves in gardens. Extremely destructive.

1058. *P. obliqua*, Cooke, Micr. Fung. p. 160, fig. 269. Floccis brevissimis, simplicibus vel unibrachiatis; sporis oblongo-obovatis ut plurimum obliquis.

On living leaves of *Rumex*, M. C. Cooke. Sent also some years since by Dr. Montagne, under the name of *Ascomyces Rumicis*, from France, where it was gathered by Durieu de Maisonneuve.

Spores with a slight swelling towards the base, ·001 inch long, often set on obliquely. Sometimes they give off below a second spore; and we have once seen a septum in the threads.

1059. *Septonema elongatispora*, Preuss, in St. Deutschl. Fl. 1851, vol. vi. p. 72, tab. 36.

On nettle-stems. Batheaston, Oct. 1864.

1060. *Helvella gigas*, Kromb. tab. 20.; Curr. l. c. fig. 25.

Blackheath Park, F. Currey.

**Peziza* (Helvelloideæ) *cerea*, Sow. t. 3.

This species occurred abundantly on leaves and sticks in a hothouse at Lord Lindsay's, Uffington, Lincolnshire, March 26, 1862.

1061. *P.* (Helvelloideæ) *trachycarpa*, Curr. in Linn. Trans. vol. xxiv. p. 493, tab. 51. fig. 3. Prima ætate orbicularis, fere plana, sæpissime umbilicata; disco nigro-fusco, aspero, tuberculato; extus minute granulata; sporidiis uniseriatis, globosis, muricatis.

On burnt soil. Ascot, Rev. G. H. Sawyer. (Rabenhorst, Fung. Exsicc. no. 620.)

Cups $\frac{1}{4}$ – $\frac{1}{8}$ inch broad, adpressed to the soil, substipitate or obconic. Sporidia uniseriate, globose, muricate, brown, ·0005–·0007 inch in diameter. Though the sporidia are brown under

the microscope, when thrown down on black paper they are of a whitish grey.

PLATE XIV. fig. 13. *a.* ascus with paraphysis, magnified; *b.* sporidia more highly magnified.

1062. *P.* (Helvelloideæ) *leiocarpa*, Curr. *l. c.* p. 493, f. 6. Cupula primum connivente, subglobosa, extus (præsertim versus marginem) aspera, fusco-vinosa, tenui, semipellucida, basin versus sæpe pallida, demum expansa, fere plana; hymenio olivaceo-fusco; sporidiis globosis, lævibus.

On burnt soil. Ascot, Rev. G. H. Sawyer, where this and the preceding species were abundant in the autumn of 1863. (Rabenhorst, *l. c.* no. 622.)

Cup $1\frac{1}{2}$ – $2\frac{1}{2}$ inches broad; hymenium at first pale, then dark olive-brown; sporidia uni- or biseriate, globose, perfectly even, .0003–.0004 inch in diameter.

Resembling at first *P. pustulata*, Batsch.

PLATE XIV. fig. 14. *a.* ascus with paraphysis, magnified; *b.* sporidia more highly magnified.

[To be continued.]

XLIII.—Notes on the Palæozoic Bivalved Entomostraca. No. V.
Münster's Species from the Carboniferous Limestone. By
T. RUPERT JONES, F.G.S., and J. W. KIRKBY, Esq.

[Plate XX.]

[Continued from vol. i. p. 257.]

THE earliest-described species of Carboniferous Bivalved Entomostraca are those of Count Münster. In 1830 a memoir by him appeared in Leonhard und Bronn's 'Jahrbuch für Mineralogie,' &c. (pp. 60–70), "On some Fossil Species of *Cypris* (Müller, Lamarck) and *Cythere* (Müller, Latreille, Desmarest)." After noticing what was then known of fossil *Cytheridæ*, the author briefly describes (pp. 62, 64) fourteen Tertiary species of *Cythere**, and proceeds (pp. 65, 66) to give similar brief descriptions of eight species that he had collected from the Carboniferous or Mountain Limestone at Regnitzlosan, near Hof, in Bavaria. This limestone, he says, is characterized by *Producti*; and "in the midst of it occurs a marly bed, oolitic in appearance, but on close examination the oolitic bodies are found to be organic remains; few of them, however, are distinct and uninjured. Among these are the *Cytheræ* here mentioned, which for the most part are found with the valves still united. Besides these, there are in the same bed remains of small Corals, *Cida-*

* These were figured and described, together with others, by Roemer, Jahrb. f. M. u. s. w. 1838, p. 514, &c., pl. 6.

rites, *Serpulites*, *Encrinites*, *Bellerophon*, *Productus*, *Terebratula*, *Cardium*, *Nerita*, *Trochus*, *Turritella*, &c.”

The so-called *Cytheræ* (some are found to be of different genera) are thus described (p. 65):—

- “15. *Cythere Okeni*, nob. With a smooth, somewhat flat, nearly egg-shaped, large shell.
- “16. — *suborbiculata*, nob. With a smooth, nearly orbicular, somewhat flat shell.
- “17. — *inflata*, nob. With a smooth, very gibbous, nearly egg-shaped shell.
- “18. — *Hisingeri*, nob. With a somewhat kidney-shaped smooth shell, like a small *Modiola*.
- “19. — *elongata*, nob. With a much longer shell, incurved at the middle on both sides, and smooth.
- “20. — *bilobata*, nob. With a broad, strongly kidney-shaped, incurved shell, which often has both valves.
- “21. — *subcylindrica*, nob. With a smooth, nearly cylindrical shell.
- “22. — *intermedia*, nob. With a smooth, bent, somewhat kidney-shaped shell, which seems to be a passage-form between *C. Hisingeri* and *C. elongata*.”

Count Münster intended that these should have been figured in Goldfuss's great work on the Fossils of Germany; but they have remained until now without illustration. The originals are still in the Royal Museum at Munich; but, through the kind intervention of our friend Dr. A. Oppel, the Keeper of that Museum, Herr Gümbel, State-Geologist of Bavaria, has most courteously lent us a series of specimens corresponding to those in the Münster Collection, and which he has obtained from the same Carboniferous Limestone, at Tragenau, near Hof. Some of the specimens are in good condition; others, on the contrary, are much worn, either by rolling, or probably by having been partly dissolved by percolating water.

By the careful comparison of these specimens with species published since the date of Count Münster's paper, we are enabled to remove some difficulties that lie in the way of settling the nomenclature of the Upper Palæozoic Bivalve Entomostraca, among which there is much confusion—the more so since some of the Carboniferous species continue to appear in the Permian rocks, and have been described and named anew without reference to their earlier occurrence and naming; and, again, one of us, in describing some Permian forms, adopted for one* of them one of Count Münster's names, urged by too great care in the avoidance of new terms, and by some rashness in trying to re-

* *Cythere elongata*, Jones; subsequently modified, on good grounds, by Geinitz to *C. subelongata*.

cognize specific forms by the Count's very brief notice of a few features.

The series of specimens sent us by Herr Gümbel include examples of all the forms described by Count Münster, besides one which he has not described. Our opinions on the species and their generic relations, as derived from these specimens, are expressed in the following notes.

1. *Leperditia Okeni*, Münster, sp. Pl. XX. figs. 1-3;
var. *acuta*, fig. 4.

Cythere Okeni, Münster, Jahrbuch f. Min. 1830, p. 65, no. 15.

Cypris Scotoburdigalensis, Hibbert, Transact. Royal Soc. Edinb. vol. xiii. p. 179, figs. a-c, 1836; Portlock, Geol. Rep. Londonderry, p. 316, pl. 24. fig. 13 c, 1843. (Small variety.)

Cypris inflata, Murchison, Sil. Syst. p. 84, fig. A, 1839. (Probably a small variety, like the last mentioned.)

Cypris subrecta, Portlock, *ibid.* fig. 13 b, 1843.

Cytheræ arcuata (fig. 9), *cornuta* (fig. 12), *elongata* (fig. 13), *Hibbertii* (fig. 15), *inornata* (fig. 18), *scutulum* (fig. 21), *oblonga* (fig. 22), *spinigera* (fig. 23), *gibberula* (fig. 25), in pl. 23 of M'Coy's 'Synops. Carb. Foss. Ireland.' (Probably either varieties or imperfectly drawn small specimens of *L. Okeni*.)

Bairdia lævigata, var. *nigrescens*, D'Eichwald, Lethæa Rossica, p. 1342, pl. 52. fig. 5, 1860.

Length $\frac{1}{37}$ — $\frac{1}{10}$ inch, height $\frac{1}{54}$ — $\frac{1}{15}$ inch.

This is a *Leperditia*, with the hinged or dorsal border usually a little over half the entire length, and the free or ventral margin boldly rounded and somewhat oblique; valves either moderately convex or strongly gibbous, but always more or less swollen, and sometimes ridged, at the dorsal region of the left valve, as other *Leperditia* are; and either meeting along the ventral margin with a slight flange or with the right strongly overlapping the left valve; surface smooth.

None of our Bavarian specimens show either eye-spot or muscle-spot; but these are sometimes visible on other specimens. The various sizes of the individuals indicate probably differences of age, habit, and perhaps sex. Fig. 1, Pl. XX. may be regarded as the normal subovate form. Fig. 2 is smaller, more oval and obtuse, and rather more gibbous in proportion. Fig. 3 is still smaller, but is like fig. 1 in its proportions. Fig. 4 is small and very acute anteriorly: it is associated in Scotland and elsewhere, as in Bavaria, with the other varieties; we may term it var. *acuta*.

L. Okeni is found in Russia* and in Nova Scotia†, as well as in Germany, Belgium‡, and in the Upper and Lower Carboni-

* As we learn from specimens kindly sent to us by M. E. d'Eichwald.

† Dr. Dawson's collection comprises some specimens from Horton, N. S.

‡ Known to us by specimens from M. Bosquet.

ferous strata throughout the British Isles. The largest specimens we have seen were found by Mr. C. Moore, F.G.S., in the Mountain-Limestone at Weston-super-Mare, in Somerset. *L. Okeni* never seems to have quite such sharp angles at the end of the hinge-line as *L. Balthica* and other Silurian *Leperditia* have.

2. *Leperditia oblonga*, n. sp. Pl. XX. fig. 5.

Length $\frac{1}{25}$ inch, height $\frac{1}{40}$ inch.

Among the specimens of *L. Okeni* with which M. Gümbel favoured us are a few Entomostraca that do not belong to that species. One of these is a small *Leperditia*, nearly oblong, with rounded ends, nearly alike in contour, but one rather flatter than the other; the hinge-line long and straight; the ventral line gently and evenly curved; surface smooth.

Such small oblong *Leperditia* as this are rare, but are found in the Carboniferous rocks, and form a passage from *L. Okeni* (which in its small varieties imitates the small Silurian *Leperditia*: see Ann. Nat. Hist. ser. 3. vol. i. pl. 10) to *L. Koninckiana*, nob. MS., of the Carboniferous Limestone of Belgium.

3. *Leperditia parallela*, n. sp. Pl. XX. figs. 6 a, 6 b.

Length $\frac{1}{44}$ inch, height $\frac{1}{120}$ inch, thickness $\frac{1}{100}$ inch.

This is a still smaller *Leperditia*, long, gibbous, and almost cylindrical, with long straight hinge-line, coming forward almost flush with the gently rounded anterior end, and retreating from the obliquely rounded hinder end; ventral edge nearly straight, sharply curving at its posterior end, and obliquely rising in front.

4. *Leperditia suborbiculata*, Münster, sp. Pl. XX.
figs. 7 a-7 c.

Cythere suborbiculata, Münster, Jahrb. f. Min. 1830, p. 65, no. 16.

Length $\frac{1}{17}$ inch, height $\frac{1}{23}$ inch.

Excepting for convenience' sake, and from the possibility of the soft parts of the Entomostracan inhabitant of such a carapace having some difference in its inner organs from those of the ovate *Leperditia*, we could not venture to separate this shorter and rounder form from *L. Okeni*; and, after all, any differences the animal had may have been sexual only. Excepting in being nearly orbicular (the ventral margin having a very bold curve, and being only slightly oblique anteriorly), it does not appear to differ from the more common form, with which it is associated in Britain as in Bavaria. It has a moderate ventral overlap, and has the dorsal hump on the left valve. Probably it ought to be regarded as *L. Okeni*, var. *suborbiculata*, Münster.

5. *Cytherella** (?) *inflata*, Münster, sp. Pl. XX. figs. 8 a–8 c.

Cythere inflata, Münster, Jahrb. f. Min. 1830, p. 65, no. 17.

Length $\frac{1}{15}$ inch, height $\frac{1}{20}$ inch.

A swollen, nearly ovate form, with the dorsal border faintly convex and the free margin elliptical. The anterior extremity is somewhat more acute than the posterior. The valves are thick, very gibbous ventrally and rather anteriorly, sloping gradually to the dorsal border and backwards, but pinched up suddenly anteriorly; they are also margined along their free edges with a slightly lipped rim, and have a faint circular hummock in a shallow hollow in their centre.

The same form occurs in the Carboniferous Limestone of Visé, in Belgium, and in the Carboniferous (marine) shales of Craigenglen, Campsie, Scotland. It is evidently not a *Cythere*, but approaches more nearly to *Cytherella*, in which genus we have placed it.

The foregoing are figured in Pl. XX. with the dorsal margin upwards; the following (*Bairdia* and *Cytheræ*) are figured with the anterior end upwards.

6. *Bairdia*† *Hisingeri*, Münster. Pl. XX. fig. 12 a–12 c.

Cythere Hisingeri, Münster, Jahrb. f. Min. 1830, p. 65, no. 18.

Bairdia Schauerothiana, Kirkby, Ann. Nat. Hist. ser. 3. vol. ii. p. 329, pl. 10. fig. 14, 1858; and Trans. Tyneside Nat. Field-Club, vol. iv. 1859, p. 147, pl. 9. fig. 14, and woodcut 10.

Length $\frac{1}{13}$ inch, height $\frac{1}{27}$ inch.

A good *Bairdia*, with a straight, abruptly sloping posterior extremity, an arched dorsal margin, a slightly convex inwardly sloping anterior extremity, and a nearly straight ventral margin; the valves swell most in the centre, and slope away to rather trenchant edges at each extremity.

The single example of this species among Herr Gümbel's Bavarian specimens enables us to identify it with *Bairdia Schauerothiana*, Kirkby, of the Permian strata of Durham. *Bairdia* the same as this occur also in the Carboniferous strata of Britain.

7. *Bairdia elongata*, Münster. Pl. XX. figs. 14 a–14 c.

Cythere elongata, Münster, Jahrb. f. Min. 1830, p. 65, no. 19.

Length $\frac{1}{9}$ inch, height $\frac{1}{30}$ inch.

A curious elongate subcylindrical form, more than three times

* As one of us has already indicated (Monogr. Tert. Entom. pp. 9 & 54), there is no doubt of *Cytherella* being generically distinct from *Cythere*, and probably a member of a different family—namely, of the *Cypridinidæ*.

† *Bairdia* is not yet proved to be generically distinct from *Cythere*; but it is convenient to use the term independently.

as long as high, with a flatly arched dorsal and an incurved ventral border; valves highest near anterior extremity, which is bluntly pointed; valves lowest near posterior extremity, which, though imperfect in our specimens, has been decidedly more acute than the anterior.

The worn and somewhat imperfect specimen from which we describe these characters gives evidence of having possessed the overlapping ventral flap of the left valve common to all *Bairdia*. The general contour of the specimen also indicates the same generic affinity, although, at the same time, it cannot but be remarked that this is not a typical species of the genus.

8. *Bairdia subcylindrica*, Münster. Pl. XX. figs. 13 a, 13 b.

Cythere subcylindrica, Münster, Jahrb. f. Min. 1830, p. 65, no. 21.

Length $\frac{1}{2}$ inch, height $\frac{1}{4}$ inch.

A pretty, slender *Bairdia*, with an evenly arched dorsal border, an obtuse anterior and a more acute posterior extremity, and a slightly concave ventral border; valves rounded, thickest in the centre, and smooth (?).

This resembles *Bairdia gracilis* of M'Coy (from the Carboniferous Limestone), with which possibly it is identical. A similar form occurs also in Permian Limestone.

9. *Cythere bilobata*, Münster. Pl. XX. figs. 10 a, 10 b.

Cythere bilobata, Münster, Jahrb. f. Min. 1830, p. 65, no. 20.

Length $\frac{1}{3}$ inch, height $\frac{1}{4}$ inch.

Dorsal border highly arched, with the anterior slope shortest; posterior extremity a little less blunt than the anterior; ventral border incurved; valves very convex and smooth (?).

The only specimen of this form in the Bavarian series scarcely gives so good an idea of the species as some which we have from British and Belgian localities. We have examples, at least, which show the ventral incurvation more decidedly than the specimen figured; and it is from this feature that Count Münster seems to have named the species. It occurs also in Russia.

10. *Cythere intermedia*, Münster. Pl. XX. figs. 9 a-9 e.

Cythere intermedia, Münster, Jahrb. f. Min. 1830, p. 65, no. 22.

Cythere subreniformis, Kirkby, Trans. Tyneside Nat. Field-Club, vol. iv. p. 154, pl. 11. f. 23.

Length $\frac{1}{7}$ inch, height $\frac{1}{8}$ inch.

The only good-sized specimen (figs. 9 a-9 c) of this species in the series is imperfect. It would appear to be the same as a Permian species described by one of us as *Cythere subreniformis*. A smaller specimen (figs. 9 d, 9 e) belongs to the same species.

C. intermedia occurs also in Mr. Charles Moore's collection of British Carboniferous Entomostraca.

11. *Cythere Muensteriana*, n. sp. Pl. XX. figs. 11 a, 11 b.

Length $\frac{1}{14}$ inch, height $\frac{1}{36}$ inch.

The specimen from which we describe this species was sent to us as *Bairdia elongata*, from which, however, we are satisfied it is distinct.

It is nearly three times as long as high, and has a flatly convex dorsal border, abruptly sloping towards the obtusely pointed extremity; the other extremity is subtruncate; the ventral border is somewhat hollow; the valves are rather flat, thickest near the middle, and slope gently away to each extremity.

As a summary of Münster's species, we may add that—

- Münster's No. 15. *Cythere Okeni* = *Leperditia Okeni* (comprising *L. subrecta* and many others).
 „ 16. *C. suborbiculata* = *L. suborbiculata*.
 „ 17. *C. inflata* = *Cytherella inflata*.
 „ 18. *C. Hisingeri* = *Bairdia Hisingeri* (comprising *B. Schaurothiana*).
 „ 19. *C. elongata* = *B. elongata*.
 „ 20. *C. bilobata* = *Cythere bilobata*.
 „ 21. *C. subcylindrica* = *Bairdia subcylindrica* (comprising *B. gracilis*).
 „ 22. *C. intermedia* = *Cythere intermedia* (comprising *C. subreniformis*).

All of these, except *B. elongata*, we know to be more or less abundant in the Carboniferous strata of Britain and elsewhere; and some are Permian "recurrents."

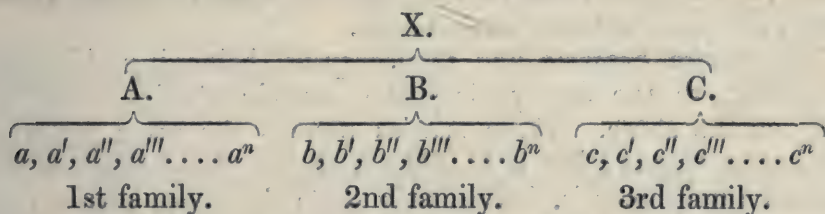
XLIV.—*The Darwinian Hypothesis supported by Observations on Crustacea.* By FRITZ MÜLLER, of Desterro.

UNDER the title of 'Für Darwin,' Dr. F. Müller has published a series of careful and minute observations on certain forms of Crustacea, which, he thinks, furnish a means of testing the soundness of the Darwinian hypothesis. Whether the facts described by him have really the bearing which he attributes to them may be a question; but there can be no doubt as to the value and interest attaching to his observations. The following abstract of some of the more important portions of this work is derived from the notice in the 'Bibliothèque Universelle,' 1865, "Bulletin Scientifique," p. 154.

According to Darwin's theory, the natural classification of

any group of animals is at the same time the genealogical tree of that group. Dr. Fritz Müller has endeavoured, in the first place, to construct this natural classification or genealogical tree for the class of Crustacea; and having constructed it, he has deduced from its structure certain necessary consequences. These deductions he has then endeavoured to verify. If they could not be verified, this would be a fatal blow to the Darwinian theory; but if they proved true, they would furnish, if not a proof, at least a strong presumption in favour of the theory. Hitherto his deductions have been verified; and thus his work presents us with a remarkable example of important results in natural history obtained by a purely deductive method, in opposition to most of the discoveries in that science, which are made by means of a sort of inductive groping.

Zoologists distinguish several natural families of Crabs. The species of one of these families, which may be designated as a, a', a'', a''' , &c., have certain characters in common; and this is the case, according to Darwin's hypothesis, because they descend from a common ancestor, A, which already presented these characters. In the same way, the species b, b', b'', b''' , belonging to a second family, present all the characters of the family because they descend from a common ancestor, B; and the species c, c', c'', c''' of a third family have certain common characters derived from an ancestor C, and so on. Lastly, the species of all these families present certain ordinal characters common to all, and due to the fact that the forms A, B, C descended from a single primitive type, X. Thus the genealogical tree of these Crustacea would be as follows:—



[Now it is to be remarked that in each of these families we find, as exceptions to the normal mode of life of the Crabs, certain terrestrial species.] It is permissible to suppose *à priori* that these must present certain modifications of the respiratory apparatus, enabling them to respire air. And it is possible to imagine a multitude of arrangements capable of leading to this result; and if each terrestrial species has gradually renounced the aquatic mode of life on its own account, there is every probability that each of them would present a modification *sui generis*, very different from those presented by the others. If,

on the contrary, observation proved that all these terrestrial species present the same modification of the respiratory apparatus, the Darwinian theory could only account for them by assuming that these terrestrial species belonging to various families, which we may designate as a^t , b^t , c^t , &c., descended directly from a common type, T, which had already acquired the organic conditions of aërial respiration. But then the theory would contradict itself; for whilst the study of the respiratory organs would compel us to make a^t , b^t , c^t , &c. descend from T, the examination of the distinctive characters of the families leads us to assign to each of these types a different origin, as it makes a^t descend from A, b^t from B, and c^t from C.

The details of the organization of the respiratory apparatus in the land Crabs have hitherto been unknown; and thus a fine field of investigation was open for Dr. Müller. If he found in the terrestrial species of different families the same arrangement for effecting aërial respiration, the Darwinian theory would be irrevocably condemned; but if he should discover differences so complete as not to be reducible to the same type, this would certainly furnish a strong argument in favour of the theory: and the latter alternative has proved to be the true one.

In an *Aratus* which climbs upon the branches of the mangroves, and in a *Grapsus* which runs about the rocks of Santa Catharina, the air finds entrance to the branchial cavity by a fissure situated above the last pair of feet. These Crabs open this respiratory fissure by elevating the posterior extremity of the carapace. This aperture is consequently at the extremity of the branchial cavity opposite to that by which water enters and issues; for the apertures for the ingestion and egestion of water are in the same position in all Crabs.

The genera *Sesarma* and *Cyclograpsus*, belonging, like the preceding, to the family Grapsidæ, contain species living in holes on the shore. These species possess the same posterior respiratory fissure; but it is difficult to see this gaping, as the animals rarely open it, indeed only when they have been a very long time out of the water. This is due to a very curious arrangement, which does not exist in the preceding species, and which enables these animals for a long time to respire the air dissolved in the water that bathes their branchiæ. The pterygostomian region which separates the apertures for the ingestion and egestion of water is, as it were, reticulated, and bristles with small recurved hairs, already indicated by Milne-Edwards. The water issuing from the egestive orifice spreads in an instant over this network of hairs, and becomes saturated with air, after which it is conducted by a special arrangement into the ingestive aperture. The same portion of water may thus pass through

the branchial chamber a great many times, carrying always a fresh supply of oxygen with it. In moist air this circulation of water may be maintained for a very long time; but when the provision of water is evaporated, the Crab has recourse to the posterior aperture for aërial respiration.

The arenicolous *Ocypodæ* have become so completely estranged from an aquatic mode of life that a stay of one day in sea-water is sufficient to kill them. It has long been observed that in these animals the third and fourth pairs of feet are exceedingly close together. The contiguous surfaces of these legs are clothed at the margins with a dense coat of hairs. It has been supposed that these hairs were intended to diminish the friction of the surfaces; but this is evidently a mistake. Dr. Müller has discovered between the bases of these approximated legs an aperture leading into the respiratory cavity. This arrangement exists in several species of the family, in particular in certain *Gelasimi*, some of which inhabit the mangrove-swamps, whilst others run about upon the sand in open day.

One might perhaps be tempted to give a teleological explanation of these differences in the organization of the respiratory apparatus, and say that the *Ocypodæ*, for example, living in the sand, require to have the orifice more protected against the introduction of foreign bodies, and consequently more concealed, than the Grapsidæ. But this argument may be refuted by more than one reason. It is sufficient to state that a *Gelasimus* which lives far from the sands, in the mangrove-forests, in company with several Grapsidæ, nevertheless has the respiratory fissure concealed between the third and fourth pairs of feet.

The Crustacea present several very distinct modes of development—the development of the Podophthalma, that of the Edriophthalma, and that of the Entomostraca (including Cirripedes). Certain Podophthalma issue from the egg under their definite form; this is the case in the common Crayfish (*Astacus fluvialis*) and in an Indian terrestrial *Gelasimus*. But all the marine Podophthalma appear to present themselves under larval forms, which is a further verification of the law which is evidently prevalent among the Annelida, Turbellaria, and Mollusca, in accordance with which the terrestrial or fluviatile species undergo no metamorphoses, whilst the marine species are subject to such changes. In any case, the Podophthalma with larvæ appear to be developed upon a single plan. In the larval state they present the form of a *Zoëa*. The *Zoëæ* are creatures entirely destitute of a thorax, that is to say, of that region of the body, which in the Crabs and Lobsters bears the five pairs of locomotive appendages to which the Decapoda owe their name. Their

abdomen, which is divided into several segments, and their tail are destitute of appendages, and the latter is formed of a single piece. Their mandibles are destitute of palpi, like those of insects. Their footjaws, of which the third pair are still wanting, have not yet passed into the series of buccal organs, but always present the form of bifurcate natatory feet. There is always a carapace, of which the sides are the seat of the function of respiration. The water, by means of which this function is performed, forms a current which passes beneath the margin of the carapace, and which is produced by the movement of a foliaceous or ligulate appendage of the second jaw. All these larvæ have also a pair of large compound eyes, often capable of motion; and this character, taken together with that of the carapace, which covers the anterior region of the body, enables them to be immediately recognized as young Podophthalma.

Totally different from these are the larvæ of the Entomostraca and Cirripedia (including *Sacculinidae*), which are known under the name of *Nauplii*. Their oval body is destitute of all traces of divisions or segments; it bears a small, median, frontal eye, and three pairs of natatory feet, of which the first are simple and the others bifurcate. The *Nauplii* present no trace of carapace, of paired eyes, or of masticatory organs.

Lastly, the Edriophthalma present neither the *Zoëa*- nor the *Nauplius*-phase.

The fact that these three groups of Crustacea present essentially different modes of development is certainly worthy of remark. Darwin's theory, by assigning a common ancestor to all these Crustacea, presupposes that this ancestor itself presented these different modes of development. This hypothesis undoubtedly appears a bold one; and it has been reserved for Dr. Müller to demonstrate its truth by the discovery of species with a mixed development, presenting the characters of the different groups.

The most remarkable species in this respect is a Macrurous Crustacean of the genus *Peneus*, which quits the egg not under the form of a *Zoëa*, like the other Decapoda, but under that of a true *Nauplius*, perfectly similar to those of the Entomostraca. Beneath the skin of this larva the succeeding phase makes its appearance as a little Crustacean with a body divided into segments. Within the first two pairs of natatory feet two pairs of antennæ are formed, and vigorous mandibles make their appearance in the third pair. Besides these, new pairs of limbs originate further back. The integuments of the *Nauplius* are then cast off, and a true *Zoëa* issues from it, which can only be distinguished from the *Zoëæ* of the *Alphæi* and *Palæmones* by

the bifurcation of its tail, resembling that of the Copepoda. The compound eyes, indeed, are still wanting, but they soon make their appearance. This *Zoëa*-phase afterwards gives place to a phase which can only be designated as the *Mysis*-phase, so close is the resemblance of the young *Peneus* in this stage to a true Schizopod. Finally, a last moult converts this pseudo-*Mysis* into a true *Peneus*. This singular mode of development is not an isolated fact, for Dr. Müller has been able to ascertain the occurrence of very similar phenomena of metamorphosis in several allied species.

Here, then, we have the development of the Entomostraca connected with that of the Podophthalma. The *Nauplius*-form is the simplest under which a Crustacean can quit the egg. The *Zoëa*-phase is a subsequent one. The Entomostraca are hatched in the *Nauplius*-form, and attain their final form before reaching the *Zoëa*-phase. The Podophthalma live for a relatively longer time in the egg, and hence they generally quit it in the *Zoëa*-form without passing through the phase of *Nauplius*. Some, however, like *Peneus*, are hatched at an earlier relative period; and these present the whole normal series of Crustacean development, without the omission of a single phase.

The Edriophthalma (Amphipoda and Isopoda) appear to differ less essentially from the other Crustacea than would seem to be the case from their development, which is very different from that of the Podophthalma and Entomostraca. The Darwinian theory leads to the assumption that their ancestors must have passed through a *Nauplius*-phase or at least a *Zoëa*-phase, although these phases are wanting in the existing species of which we know the development. Dr. Müller, however, has discovered that the Isopoda of the genus *Tanaïs* still retain the characters of incontestable *Zoëæ*. Van Beneden had already remarked that *Tanaïs Dulongii*, although a true Isopod, nevertheless possesses a carapace like that of a Decapod. This led Dr. Müller to examine the genus *Tanaïs*, and he soon ascertained that these Crustacea, instead of having respiratory abdominal feet like the other Isopoda, have only locomotory feet, into which no blood-globules ever penetrate. To make up for this, respiration is localized in the lateral parts of the carapace, which are constructed for this purpose exactly as in *Zoëa*. The stream of water necessary for respiration is maintained, as in the *Zoëæ* and the adult Decapods, by the exognath of the second pair of maxillæ, which is deficient in all other Edriophthalma.

Dr. Müller records an exceedingly curious fact with regard to a species of the genus *Tanaïs* (*T. dubius* ?, Kr.), namely, the occurrence of a new kind of dimorphism in the males. In this

species, the individuals of which live together in myriads, the young males closely resemble the females. But the last moult gives origin to two very distinct forms of males. Some of them are furnished with enormous, elongated and very mobile nippers, and with anterior antennæ having as many as twelve or even seventeen olfactory filaments, of which the antennæ of the females do not exhibit one. The others retain short and heavy pincers, very similar to those of the females; but their antennæ have incomparably more numerous filaments than those of the first form of males.

The fact of this singular dimorphism does not appear to Dr. Müller to be inexplicable by the Darwinia hypothesis. Natural selection must have tended to favour the varieties in which the males could most readily make sure of the possession of the females. Hence, on the one hand, those males which were furnished with vigorous and mobile nippers fitted to seize the females, and, on the other, those furnished with olfactory organs adapted to guide them in the search after the females, have prevailed in the struggle for existence.

XLV.—*Remarks on Observations contained in Dr. Günther's Work on the Reptiles of British India.* By T. C. JERDON, Surgeon-Major.

To the Editors of the Annals and Magazine of Natural History.

GENTLEMEN,

Dr. Günther, in his elaborate work on the Reptiles of British India, in a note at page 99, writes as follows:—"Mr. Jerdon describes a Scaled Gecko (*Homonota fasciata*, Journ. Asiat. Soc. xxii. 408); but the descriptions given by that gentleman are so obscure (partly because he rarely hit upon the proper generic name, and partly because the few words serving for a description generally contain the most trivial characters) that in this case we are at a loss to imagine what sort of Lizard is the type of *Homonota fasciata*."

Now, Gentlemen, this paragraph is based upon an error, is unjust, not to say untrue, in part of its censure, and is offensive and illiberal in its tone, as are several other allusions to my brief Catalogue of Reptiles, compiled in 1849-1850; but these I share with others.

It is based upon error; for it so happens that the name and description of *Homonota fasciata* (as might have been seen by the manner of its interpolation) were given by Mr. Blyth at my

request, as the only specimen of that Lizard I ever procured was sent by me to the Museum of the Asiatic Society, Calcutta. It appears to me, moreover, that very little attention would have enabled Dr. Günther, had he been so inclined, to have identified this Lizard, which is either *Gymnodactylus deccanensis*, Günther, or some very closely allied species; but I shall leave it to Mr. Blyth to inquire why Dr. Günther should be so completely at a loss to imagine what sort of Lizard is the type of his *Homonota fasciata*, as well as to identify other species of reptiles described by the late accomplished Curator of the Asiatic Society.

It is unjust, not to say untrue, as well as offensive in its tone, in that part of his paragraph where he says that I “rarely hit upon the proper generic name;” for, Gentlemen, you will hardly be prepared to believe that out of about one hundred species of true reptiles noted in my catalogue, only seven are not referred to their proper genera as recognized at the time; and in some even of these few the error is very excusable, as I shall now point out. The seven species of Reptiles wrongly referred by me are, three species referred to *Cylindrophis*, one to *Xenopeltis*, and three to *Leptophis*. Of these, the Snakes referred to *Cylindrophis* belong either to the allied genus *Rhinophis* or to *Silibura*, or to both. The Snake referred to *Xenopeltis* is a new form, recently named *Geophis* by Dr. Günther, which he, in his ‘Catalogue of Colubrine Snakes in the British Museum,’ classed as a *Rhabdosoma*. It is, however, evidently Duméril and Bibron’s *Platypteryx Perroteti*, rightly stated by them to be found on the Neelgherries, where I procured my specimens; and I may state that the only specimen in the British Museum when Dr. Günther compiled his Catalogue was presented by myself. Of the three Snakes referred by me to *Leptophis*, one is *Psammophis condonarius* (as I myself afterwards recognized when I obtained large specimens in Central India), whilst the other two, if specifically distinct, belong to a new form, now called *Tropidococcyx* by Dr. Günther, and which in his Catalogue he classed under *Dryophis*, and Duméril and Bibron under *Psammophis*.

Of the twenty-seven or twenty-eight Batrachians noted in my Catalogue, the great majority are correctly referred to their proper genera as then recognized; and I am only in doubt as to the species referred to the genera *Limnodytes*, *Phyllomedusa*, and *Hylædactylus*. Of these I believe the latter to be rightly classed; but the frogs referred to the two former genera—at all events that referred to *Phyllomedusa*—may turn out to be a new form. None of these last four species are very rare in parts of South India, and specimens ought to be sent home for identification. I may here state that, fifteen years ago, in my Catalogue, I

correctly referred a Batrachian to its proper genus, *Pyxicephalus**, which Dr. Günther, in his Catalogue of Batrachians, referred to a new genus, *Sphærotheca*, and subsequently to *Tomoptera* of Bibron.

With these exceptions now particularized, I can safely aver, and moreover am able to prove, that the whole of the Reptiles of my Catalogue were referred to their proper genera, or, to speak more correctly, were rightly so referred according to the usual or received nomenclature at the time when they were published. Should Dr. Günther refuse his assent to this statement, it will then be my task (although the *onus probandi* rests on him) to show in detail that he has made a statement injurious to me, which he cannot justify; but I earnestly hope, for the sake of science, and to promote the good feeling that ought to prevail among all lovers of science, that he will have the good sense and manliness to come forward at once and publicly state that his sweeping and uncalled-for assertion, that throughout my Catalogue I had rarely hit upon the proper generic name, was made without foundation. With regard to Dr. Günther's other criticisms on the insufficient characters given by me in my Catalogue, I at once acknowledge their force; but he ought to have considered that I was not writing a description of new species, but only compiling a catalogue chiefly for the use of observers in this country, and, moreover, that the most imperfect portions (the Ophidians and Batrachians) were compiled, as was stated at the time, under most unfavourable circumstances, viz. when I was separated unavoidably from my collections (some of which I never again recovered); and the few characters I gave were drawn up from some rough pencil notes attached to my drawings.

I am, Gentlemen,

Yours obediently,

T. C. JERDON,

Surgeon-Major.

Camp, Kurnal, Feb. 24, 1865.

P.S. I have forwarded a copy of this communication to Dr. Günther, through Dr. J. E. Gray, in order that he may, if he wish to do so, insert his reply in the same number of your Magazine in which this letter will appear†.

* *Pyxicephalus breviceps*, apud Günther, 'Reptiles of British India.'

† We are requested by Dr. Günther to state that he has been compelled, by pressure of other matters, to defer for the present his reply to the above letter.—Ed.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

March 2, 1865.—Major-General Sabine, President, in the Chair.

“On the Marsupial Pouches, Mammary Glands, and Mammary Fœtus of the *Echidna hystrix*.” By Professor Owen, F.R.S.

In a communication to the Royal Society on the generative economy of the Monotremata*, Prof. Owen showed that the ovum left the ovarium with a spherical vitellus $1\frac{1}{2}$ line in diameter, and attained a diameter of $3\frac{1}{2}$ lines in the uterus, the increase of size being due to increase of fluid between the chorion and vitelline tunics. This fluid, homologous with the albumen of the egg of oviparous vertebrates, did not coagulate in alcohol, and the only change presented by the vitellus of the largest observed ovum was a separation from the “food-yolk” of a “germ-yolk” in the form of a stratum of very minute granules, adhering to part of the membrana vitelli. There was no trace of decidua in such impregnated uteri; the smooth chorion was firmer than that of uterine ova of Rodentia; whence, and for other reasons given in the Paper above cited, it was inferred “that the *Monotremata* were essentially ovo-viviparous.”

The impregnated uteri of the *Ornithorhynchus* there described were of females killed in the month of October. In the early part of December 1833, young *Ornithorhynchi*, obtained from the nest, were transmitted by Dr. George Bennett, F.L.S., of Sydney, N.S.W., to Prof. Owen: they were naked, blind, with short, broad, flexible, and softly labiate mandibles, the tongue proportionally large, and reaching to near the end of the mandibles; the mouth not round, as in the mammary fœtus of Marsupials, but a wide transverse slit; a pair of small patulous nostrils opened upon the upper mandible, and between them was a small prominence resembling the knob on the beak of the newly-hatched chick, but softer, and lacking the cuticle, which had been torn off. There was no trace of navel or umbilical cicatrix.

The phases of the development of the mammary glands of the *Ornithorhynchus* were the subject of another communication, and, with the peculiar formation of the mouth of the young animal, demonstrated that it was nourished by milk as other mammals. The smallest of the young of the *Ornithorhynchus* so obtained did not exceed two inches in length.

At the early part of the present year (1865), Prof. Owen received from Dr. Mueller, F.R.S., of the Botanical Gardens, Melbourne, Australia, a female *Echidna* (*Ornithorhynchus Hystrix*, Home, *Echidna Hystrix*, Cuv.), with a young one, which the captor found adhering to the mother, as he supposed, by a nipple. They were transmitted in spirits, and their description forms the chief subject of the present communication. In regard to the parent, the description is limited to the parts concerned in generation.

* “On the Ova of the *Ornithorhynchus paradoxus*,” Philosophical Transactions, vol. cxxiv. p. 555.

The marsupial pouches are two in number, about $1\frac{1}{2}$ inch apart, each with the aperture longitudinal and towards the medial line, on the ventral integument, half an inch in depth and two-thirds of an inch in length. The young *Echidna*, about one inch in length in a straight line, could be received in a bent posture into the pouch, and might cling to the fine hairs of that part by its claws; but there was no trace of nipple. Each mammary gland terminates by numerous ducts upon the fundus of the corresponding pouch.

The left ovary, as in the *Ornithorhynchus paradoxus*, was of an oblong flattened form, developed from the posterior division of the ovarian ligament and corresponding wall of the ovarian capsule; it consisted of a rather lax stroma, invested by a smooth, thin, firm "tunica propria," which glistens where stretched over the enlarged ovisacs. Of these there were five, of a spherical form, most of them suspended by a contracted part of their periphery, not stretched into a pedicle, to the rest of the ovary—the largest with a diameter of $1\frac{1}{2}$ line, the least of the five with a diameter of rather less than 1 line. Besides these there was a flattened ovisac, $2\frac{1}{2}$ lines in length, and 2 lines in opposite diameters, of a flattened pyriform shape, with a somewhat wrinkled exterior, attached by the base, with the apex slightly tumid, and showing a trace of a fine cicatrix. This was an ovisac from which an ovarian ovum had been discharged.

The oviducal branch of the ovarian ligament passes, as in the *Ornithorhynchus*, to the outer angle of the wide oviducal slit or aperture, which occupies or forms the margin of the ovarian pouch opposite to that to which the ovary is attached. The ligament spreads upon the inner wall of the infundibular part of the oviduct, and rejoins the ovarian division of the ligament to be continued along the oviduct, puckering up its short convolutions into a small compass. The "fallopian" aperture of the infundibulum is a longitudinal slit of 9 lines in length, with a delicate membranous border extending about a line beyond where the muscular and mucous tunics of the oviduct make the thin wall of the infundibulum opaque, its transparency against a dark ground contrasting with the opaque beginning of the proper tunics of the oviduct, which nevertheless are here very thin. No part of this delicate free margin is produced into fimbriæ; in this respect *Echidna* accords with *Ornithorhynchus*, and equally manifests the character by which the Monotremes differ from the Marsupials. The infundibular dilatation suddenly contracts about an inch from the opening into a "fallopian" tube, about a line in diameter, which is puckered up into four or five short close coils. The oviduct, after a slight contraction, suddenly expands into the uterus. This is about 2 inches long, and 6 lines in diameter. It commences by a short well-marked bend, convex outwards, and then proceeds nearly straight, the pair converging to the urogenital compartment, slightly contracting at its termination, which projects, as an "os tincæ," into the side of the fundus of that division of the cloaca.

The tunics of the uterus are, externally, the peritoneum, which is attached by a lax cellulosity to the "tunica propria;" this,

with its fibrous or muscular layer, is thin, not exceeding $\frac{1}{8}$ th of a line in the present specimen. The inner layer of the uterine wall is the thickest, and chiefly composes it, consisting of fine lamellæ stretched transversely between the fibrous layer and the fine smooth lining membrane, the whole being of a pulpy consistence, and doubtless in the recent animal highly vascular, especially in the impregnated state. The lining membrane was devoid of any trace of vascular connexion with the membranes of an ovum or foetus, and was thrown into delicate irregular rugæ, which assumed the longitudinal direction at the "cervix" or contracted terminal part of the uterus. The orifice on the "os tincæ" was a puckered slit, about a line in extent; below it, on a produced or papillose part of the prominence, was the small circular orifice of the ureter.

The right ovary was proportionally more developed and larger than in the *Ornithorhynchus paradoxus*; three ovisacs were developed and attached, as in the left ovary; and there was also a compressed ovisac, similar in size and shape to that in the left side, and exhibiting an apical cicatrix, whence it is to be inferred that, in this instance, the right as well as the left ovary had furnished an impregnated ovum; and the near equality of size and close similarity of structure and condition of the right oviduct and uterus equally indicated that they had participated in the functions of the last season of generation.

The urinary bladder opened into the middle of the fundus of the urogenital compartment, the uterine orifices intervening between the vesical one and the ureters, as in the *Ornithorhynchus paradoxus*. The urogenital canal is 1 inch 4 lines in length, and about 9 lines in diameter; its inner surface shows by some coarse wavy longitudinal rugæ its capacity for dilatation. The rectum was here of great width; it terminated by a contracted puckered aperture in the back part of the beginning of the vestibule, behind the aperture of communication of the urogenital with the vestibular canal. The distal half of the vestibule is lined by a denser and less vascular epithelium than the proximal one. The author concludes, from these appearances, that the present *Echidna* had produced two young, of which only one was secured, and that probably she had a mammary foetus in each pouch prior to her capture.

The one which was secured resembled the young of the *Ornithorhynchus* in the general shape and curvature of the body, and also resembled the new-born young of the Kangaroo in the proportions of the limbs to the body, in the inferior size of the hind pair, in the degree of development of the digits, especially of the fore pair, and in the feeble indication of eyes or eyelids. But the mouth is proportionally wider, and has the form of a transverse slit; it is not circular. Upon the upper lip, in the mid line between the two nostrils, is a small protuberance corresponding to that in the young of the *Ornithorhynchus paradoxus*, which had been covered by some epidermal production. The traces of ears are less conspicuous than in the young Kangaroo, the conch being little, if at all, developed in the mature *Echidna*.

The tail is much shorter than in the young Kangaroo, and shows as much proportional size as in the full-grown *Echidna*, in which it is a mere stump concealed by the quills and hair.

The head is proportionally longer and more slender in the marsupial foetus of the *Echidna* than in that of the *Ornithorhynchus* or of the Kangaroo, and already at this early period foreshows the characteristic elongation and attenuation of that part in the mature animal. The form of the mouth, as a transverse slit, is a good monotrematous character of the young at that period, since, in all true or teated marsupials, the mouth of the mammary foetus has a peculiar circular and tubular shape. A scarcely visible linear cicatrix at the middle of the lower part of the abdomen is the sole trace of umbilicus.

A bifid obtuse rudiment of penis or clitoris projects from the fore part of the single urogenital or cloacal aperture, and in advance of the base of the tail-stump.

The brain, of which the largest part was the mesencephalon, chiefly consisting of a vesicular condition of the optic lobes, had collapsed at this part, leaving a well-defined elliptical fossa of the integument, indicative of the widely open fontanelle at the upper part of the cranium.

The skin of the shrunken body showed folds, indicative of the originally plump, well-filled abdomen.

The fore limbs, in their shortness and breadth, foreshow the characteristics of those of the parent, which may be said, indeed, to retain in this respect the embryonic character, with superinduced breadth and strength. The digits have already something of the adult proportions, the first or innermost of the five being the shortest; the others of nearly equal length, but graduating shorter from the third to the fifth. The characteristic disposition of the digits was better marked in the hind limb, the second already being the strongest and longest, the rest more rapidly shortening to the fifth than in the fore leg. The innermost, agreeably with the law of closer retention of type in the embryo, though the shortest of the five, was less disproportionately so than in the adult.

The chief points, in the generative economy of the Monotremes, which still remain to be determined by actual observation are :—

1. The manner of copulation.
2. The season of copulation.
3. The period of gestation.
4. The nature and succession of the temporary structures for the nourishment and respiration of the foetus prior to birth or exclusion.
5. The size, condition, and powers of the young at the time of birth or exclusion.
6. The period during which the young requires the lacteal nourishment.
7. The age at which the animal attains its full size.

In respect to the second point: as the female *Echidna* with the young was captured on the 12th of August, she might be impregnated at the latter end of June or in July. Females, therefore, killed in the last week of July and the first week in August, in the pro-

vince of Victoria, would be most likely to afford the capital facts noted under the "fourth" head, viz. the impregnated ovum *in utero*, showing some stage of embryonal development in the spiny terrestrial Monotreme. As to the hairy and aquatic *Ornithorhynchus*, the impregnated females in which ova were found in the uterus, of small size, and prior to the formation of the embryo, were caught on the 6th and 7th of October. Young *Ornithorhynchi*, measuring in length in a straight line $1\frac{7}{8}$ inch, were found in the nest on the 8th of December. The period of impregnation, therefore, in this species, in the locality of the Murrumbidgee River, is probably the latter end of September or beginning of October. Females captured in the latter half of October and in the month of November, would be most likely to have ova *in utero*, exhibiting stages of embryonal development.

Professor Owen earnestly requests anyone who may obtain females of the Platypus or Duck-mole (*Ornithorhynchus*) in October and November, or females of the Porcupine-Anteater (*Echidna*) in July and the first week of August, to preserve the specimens in colourless spirits, the belly being slit open to allow access of the preserving liquor to the interior,—or, to preserve the hinder half of the specimen, the trunk being divided behind the fore limbs—or, at least, the female organs of generation, with the bladder and rectum, preserved in strong colourless spirits. These specimens may be directed to Professor Owen, care of Dr. Mueller, F.R.S., Botanic Garden, Melbourne; or to the care of Dr. George Bennett, F.L.S., Sydney; or they may be transmitted directly, addressed "To the Principal Librarian, British Museum, London," to whom the Bill of Lading should be directed, and the freight will be paid in London.

ZOOLOGICAL SOCIETY.

Nov. 8, 1864.—Prof. Huxley, F.R.S., V.P., in the Chair.

NOTES ON THE ZOOLOGY OF SPITSBERGEN. BY ALFRED
NEWTON, M.A., F.L.S., F.Z.S.

In the month of May last, Mr. Edward Birkbeck offered me a berth in his yacht, the 'Sultana,' R. T. Y. C., on a voyage to Spitsbergen. As this was a country I had long been desirous to visit, I was very glad of the opportunity of seeing it, which had so unexpectedly presented itself. On the 31st of May I found myself on board the vessel at Lowestoft, and the following morning we sailed northward. After a passage protracted by some tedious calms, we cast anchor in the Bay of Hammerfest on the evening of the 26th June. Here it was necessary to stay for some days, while a Norwegian "*jægt*" was being equipped to accompany us, and to take us, if necessary, into the ice, where the yacht, from her extreme length, would become embarrassed, and from her slight build dangerous. Late in the evening of the 2nd July the necessary preparations were completed, and the 'Semmoline,' a sloop of some thirty or forty tons, got under way. The next morning the 'Sultana' fol-

lowed, and, overhauling her consort in the narrow seas, in the course of the afternoon lost sight both of her and the land of Norway. On the afternoon of the 6th July we made the South Cape of Spitsbergen, bearing N.E.

Our first rendezvous having been appointed about halfway up the deep bay marked on English charts as Wibelan's Water, and known to Norsk walrus-hunters as Stor Fjord, which indents the archipelago of islands forming Spitsbergen, our course was altered accordingly; but we were soon brought up, after passing a good deal of drift ice, by the appearance of very closely packed ice, stretching across as far as the state of the atmosphere would allow us to see it. This to our pilot, a man whose knowledge of Spitsbergen is scarcely surpassed by any one's, was a manifest indication of the fjord being completely blocked up, and he did not hesitate to order us to proceed to our second rendezvous in Ice Sound, on the west coast. Thither we made sail, trying as we passed northward successively to enter Horn and Bell Sounds, both of which we found to be impracticable from the same cause as had been the Stor Fjord. On nearing Ice Sound, on the afternoon of the 8th July, we found a good deal of ice drifting out of its mouth; but it was of such a kind as to cause no risk to the ship, with our careful captain and pilot. While we were watching with interest the novel scene presented to us by the varied shapes of the frozen masses through which we were navigating, there was a cry of "White Whales!" and a "school" of *Beluga catodon* passed across our bows. Though there were the vivid hues of drifting ice-blocks with which to contrast them, I was agreeably pleased to see that their colour stood this high trial. When, some years ago, I saw the so-called "White Porpoises" of the river St. Lawrence, identified by Dr. Gray (Cat. Brit. Mus. Cetacea, pp. 78, 79) with this species, they had a very tallowy appearance; now the worst that could be said of these beasts is that they looked the colour and consistency of a good spermaceti candle. There were at least six or eight of them swimming at very short distances from one another, and they glided rapidly through the water with an easy and almost graceful roll, now and then emerging from the surface sufficiently to show the whole of their bodies.

It is not my intention now to say much concerning the birds of Spitsbergen; but I must mention that the Sound we were entering presents one of the most wonderful sights to the eye of the ornithologist that can possibly be conceived. The species which frequent Spitsbergen are few in number, much fewer than had been thought prior to the publication of A. J. Malmgren's admirably critical papers*; but the number of individuals is past all computation. It will be sufficient here to name the species I observed at this time, and this I shall do somewhat in the order of their comparative abundance. First *Mergulus Alle*, *Uria Arra*, and *Cepphus Grylle*; then *Rissa tridactyla*, *Somateria mollissima*, *Procellaria glacialis*, *Fratricula glacialis*, *Larus glaucus*, and, lastly, an *Anser* which I shall specify hereafter. All these, excepting *Larus glaucus*, we found

* Öfversigt af Kongl. Vetenskaps-Akademiens Förhandlingar, 11 Febr. 1863.

breeding around Ice Sound, indeed, I may say, in the immediate neighbourhood of Safe Haven, a commodious inlet on its northern shore, where the yacht dropped her anchor on the morning of the 9th July.

The whole of the next week was employed by our party in exploring, with different objects in view, the shores of the Sound, or, as it should be more properly called, fjord, for it extends at least fifty miles into the interior, and appears to have no connexion with Wilbelan's Water or any other inlet of importance. Almost every depression on its northern side is occupied by a glacier, which generally fills it nearly to the brim, and, with but one exception, these glaciers are only terminated by the sea; but along its southern shore are some four or five bays of various sizes, and between them various valleys which, being quite free from ice, are more or less fertile and afford sufficient pasturage for numerous herds of *Rangifer tarandus*. These Deer are tolerably abundant: they are certainly smaller than the Lapland Reins, whether wild or tame; and though I can hardly profess to speak generally on the subject, yet all the antlers which I saw in Spitsbergen seemed to me to be slighter in the beam than those of the continental race; nevertheless, the points being in old stags considerably elongated, the expanse of antler was not much inferior. The average type of a good Spitsbergen head is very well represented by the first figure in the 'Fauna Boreali-Americana' (vol. i. p. 240), of the so-called Barren-ground Caribou (*Cervus tarandus*, var. *α. arctica*, Richardson); and it is probable that the same causes which influence the development of the antlers in the Rein-Deer of the *mauvaises terres* in North America affect in like manner those of their Spitsbergen brethren. These last are said, by persons who have wintered there, not to migrate from the country; at least they or their tracks on the snow are seen "as soon as it begins to get light" in spring. At the same time it is just possible that some of them may wander over the frozen sea by way of Giles Land, and other islands, perhaps, of which we have as yet no knowledge, to Nova Zembla, and so on to the country of the Samoides. Certainly a hind killed by my friend Mr. Graham Manners-Sutton had one ear slit in a manner which was recognized by some of the 'Semmoline's' crew (most of them Quæns) as a mark of ownership. I must, however, add that, averse as I am to doubt the technical knowledge of an expert, the slit in question seemed to me as if it might have been very well caused by another deer in fighting, or, even if it were of human origin, such as might have been made by some one who had caught the animal when a calf, and let it go again; but this last solution of the difficulty excited a laugh at my simplicity among the Quæns, who could not conceive it possible that a hungry hunter should show compassion towards the very youngest deer. All that we saw the first week of our being in the country still retained a considerable quantity of their nearly white winter clothing, thus rendering their detection, when viewed against the dark-coloured ground, a very easy matter even at a great distance. These animals also were in poor condition, contrasting in this respect

strongly with those killed about a month later, when their bodies on being flayed were found to be covered with fat nearly two inches thick. At this time they had entirely got rid of their overcoats, and were clothed entirely in a short but close felt of dark mouse-colour. Judging from the gralloch, in the summer, lichens seem to form only a small article in their diet, their food then consisting chiefly of mosses, grasses, and any other herbage.

The Arctic Fox (*Canis lagopus*) is pretty numerous along the shores of Ice Sound; and we not only frequently saw examples of it, but in the immediate neighbourhood of the cliffs wherein the *Alcidae* were nesting one could, by listening almost at any time in the twenty-four hours, hear its yapping bark. It is of course the chief enemy of all the different kinds of birds, and their dread of it appears to influence them greatly in their choice of breeding-quarters. What the Foxes do to get a living in winter when the birds have left the country—for I imagine that the Ptarmigan (*Lagopus hemileucurus*) is the only species that is permanently resident—is one of the most curious questions that has presented itself to my mind for some time. The greater number of them are said to remain on the land, and to be as active during the long polar night as they are in summer; yet there are no berries by which they might eke out their existence, and there can be no open water, on the margin of which they might find food, within miles of their haunts. The most natural explanation that occurs to one is that they lay up a stock of provisions; but nobody, that I am aware of, has ever found such a store-closet*, or has observed any tendency to hoarding in their habits. In Spitsbergen I believe that none of the varieties known as the Blue, the Black, or the Silver Fox have been noticed. The summer pelt does not differ from what it ordinarily is in other countries, and the winter coat seems to be invariably white†.

We noticed two species of *Phocidæ* in the waters of Ice Fjord. I am indebted to Mr. Malmgren for the information that these are the *Callocephalus foetidus* and *Phoca barbata* of Dr. Gray's 'Catalogue of Mammalia in the British Museum.' The former is called by the Norwegians who frequent the coast of Spitsbergen "Steen-Kobbe," or Stone-Seal, probably because it is usually seen near rocks,

* Since the above was written, it has occurred to me that a considerable collection of shells of *Mya truncata*, which I found one day on the moraine of a glacier in Safe Haven, may possibly have been due to the cause suggested in the text.

† I have never seen it remarked, though it is unquestionably the case, that nearly all the Icelandic examples of *Canis lagopus* are "Blue" Foxes; that is to say, their winter coat is of nearly the same colour as their summer coat. This fact, I think, must be taken in connexion with the comparatively mild climate which Iceland enjoys in winter, and, if so, is analogous to the circumstance of the Alpine Hare (*Lepus timidus*, Linn., non auct.) always becoming white in winter in Scandinavia, generally so in Scotland, and but seldom in Ireland. The Common Squirrel (*Sciurus vulgaris*) is another case in point; and all three may be considered illustrative of the vexed questions of the specific distinctions between the Great Northern Falcons (*Falco gyrfalco*, *F. candicans*, and *F. islandicus*), and of the specific identity of the Red and Willow Grouse (*Lagopus scoticus* and *L. albus*).

or at any rate at no great distance from land; the latter is known as "Stor Kobbe," Great Seal, or less frequently "Blaa Kobbe," Blue Seal. How this last name came to be applied to it I do not know. As far as I can judge, it is very inappropriate. When dry, its fur is of a dirty yellowish white; and a beast of this species lying on a floe has exactly the appearance of a lump of discoloured ice, so that the hunter often takes one for the other. In the water it seems to be much of the same colour as most Seals—a dark iron-grey above, lighter beneath. It is a very powerful animal: I saw one that had received three Enfield-bullets through the nape of its neck, and had been bleeding profusely for about half an hour; yet it nearly succeeded in capsizing a large whale-boat with five men in her, owing to the clumsiness of the harpooner. We constantly saw this species at a considerable distance from land—ten to twenty miles, off the west coast of Spitsbergen, mostly between Bell Sound and Ice Fjord; and a young male of the previous year was shot from the deck of the yacht, and afterwards harpooned, on the 29th July, about fifteen miles from South Cape.

We saw no other mammals in Ice Fjord. Our pilot pointed out to me one day a place where, many years ago, a *jægt's* crew, of which he himself was one, killed nine Polar Bears; but no such good fortune attended us. This same man informed me that he knew of the occurrence in Spitsbergen of a "Hermelin," a species which has not hitherto been recorded from that country, though it is probable that the "creature, somewhat larger than a weasel, with short ears, long tail, and skin spotted white and black," stated to have been seen on Low Island by Dr. Irving in Lord Mulgrave's Voyage*, was nothing else but *Mustela erminea*.

I must here mention the pleasure it was to me, and, I am sure, to all the other members of our party, to fall in with the Swedish Scientific Expedition, who are engaged in making a series of preliminary surveys, preparatory to measuring an arc of the meridian, in Spitsbergen. To Professors Nordenskjöld and Dunér and Mr. Malmgren our best thanks are due for their kindness in furnishing us with much valuable information, the results of their former arduous explorations in this distant country.

On leaving England there had been two points in the ornithology of Spitsbergen to which I had especially meant to apply myself. The first was the obtaining of a good series of specimens of the Spitsbergen *Lagopus*, a single example of which, brought from that country in 1855 by my friends Mr. W. Sturge and the late Mr. E. Evans, had been described by Mr. Gould in our 'Proceedings' for 1858 (p. 354) as a distinct species under the name of *L. hemileucurus*; the second was the determination of the large species of Wild Goose, which the same gentlemen found breeding on the shores of Ice Fjord (Ibis, 1859, pp. 171, 172). Of the latter, as I have already mentioned, we saw a considerable number; and though we failed in our efforts to obtain a specimen, yet, through Mr. Malmgren's kind-

* 'A Voyage towards the North Pole undertaken by His Majesty's command, 1773.' By Constantine John Phipps. London: 1774, page 58.

ness, I am able to declare that the species is *Anser brachyrhynchus*, since I saw and examined two examples in his possession. Of the first, though, I regret to say, unsuccessful in finding out its haunts, I likewise had the pleasure of being shown by Mr. Malmgren an adult male, killed but a few days previously, and still unskinned. Its plumage, however, presented scarcely any trace of the great vernal change which takes place in this group of birds; and, except that I am confident that the Ptarmigan of Spitsbergen is distinct from that of continental Europe and Britain, I hardly like to form an opinion respecting its specific distinctness from the Ptarmigan of Iceland, Greenland, and Labrador, which I am inclined to consider as forming but one species, to which the name *L. rupestris*, being the oldest, should probably be applied.

After passing an agreeable week in Ice Fjord, and being joined by our Norwegian consort, we returned southwards, and proceeded towards the most western of the Thousand Islands. Here some of our party were transhipped to go to the eastward in the *jægt* in search of Walruses, while the 'Sultana' made another attempt to ascend the Stor Fjord; but, finding the ice at a distance of about twenty miles above the bight still unmoved, she was compelled to retrace her course, and await the return of the *jægt* party off the Thousand Islands. In Stor Fjord we made the acquaintance of the third species of Seal known in Spitsbergen, the very widely distributed *Pagophilus grænländicus* of Dr. Gray's Catalogue. This animal is known to the frequenters of the coast as the "Jan-Mayen Kobbe" and "Svart-side;" but most generally as the "Springer," from its lively actions in the water. It is of a sociable disposition, and we saw it in herds not less than fifty in number. These were very fond of swimming in line, their heads alone above water, engaged in a game of "follow-my-leader;" for on the first Seal making a roll over, or a spring into the air, each Seal of the whole procession, on arriving at the same spot, did the like, and exactly in the same manner. While viewing this singular proceeding (and I had many opportunities of doing so), I could not but be struck with the plausibility of one of the suggested explanations of the appearance which has obtained so wide-spread a notoriety under the name of the "Great Sea Serpent." If any rule of the game in which *Pagophilus grænländicus* loves to indulge ever would permit the leading Seal to swim (say) one-third out of water, as I have often seen *Phoca barbata* do, I could quite understand any person, not an unromantic naturalist, on witnessing for the first time such a sight as I have tried to describe, honestly believing that the mythical monster was actually before his eyes. I never had the opportunity of closely examining a "Springer;" but one learned immediately to distinguish this species from the other two I have mentioned: not only its wonderful activity in the water, but its elongated head (even when the size of its body, just about intermediate between *P. barbata* and *Callocephalus foetidus*, was not to be ascertained) was quite sufficient for that purpose. This species resorts in great numbers to the ice in the neighbourhood of Jan Mayen, whence one of its common names; and in former

years several vessels were annually equipped at Tromsö and Hammerfest in pursuit of it; but I believe that of late this practice has been a good deal discontinued.

Although none of our party were lucky enough to get a glimpse of a Walrus, I cannot refrain from mentioning here some circumstances connected with the history and habits of that curious and mighty beast. It is pretty well known that in the summer of 1853 a living example was deposited in our Gardens, which, however, after a few days languished and died, probably from having been fed on a diet so unnatural to it as oatcake*. Yet this is by no means the only instance of this animal being brought alive to England. So long ago as 1608, the ship 'God-speed,' commanded by Master Thomas Welden, performed a voyage to Cherie, now commonly called Bear Island, and in the account of the expedition it is written—

"On the twelfth [July] we took into our ship two young Morses, male and female, alieve: the female died before we came into *England*: the male liued about ten weeks. When wee had watered, we set sayle for *England* about foure of the clocke in the morning. * * *

"The twentieth of August, wee arriued at *London*; and hauing dispatched some priuate businesse, we brought our liuing Morse to the Court, where the king and many honourable personages beheld it with admiration for the strangenesse of the same, the like whereof had neuer before beene seene alieve in *England*. Not long after it fell sicke and died. As the beaste in shape is very strange, so is it of strange docilitie and apt to be taught, as by good experience we often proued"†.

Now surely what a rude skipper in the days of James I. could without any preparation accomplish, this Society ought to have no great difficulty in effecting; and I trust that the example may not be lost upon those who control our operations. From inquiries I have made, I find it is quite the exception for any year to pass without an opportunity of capturing alive one or more young examples of *Trichechus Rosmarus* occurring to the twenty or thirty ships which annually sail from the northern ports of Norway, to pursue this animal in the Spitsbergen seas. It has several times happened that young Walruses thus taken are brought to Hammerfest; but, the voyage ended, they are sold to the first purchaser, generally for a very trifling sum, and, their food and accommodation not being duly considered, they of course soon die. Lord Dufferin bought one which had been taken to Bergen, and succeeded in bringing it alive to Ullapool‡; and Mr. Lamont mentions another which he saw in the possession of Captain Erichsen§. In making an attempt to place a live Walrus in our Gardens, I do not think we ought to be

* See 'Zoological Sketches,' by J. Wolf; edited by P. L. Slater. Cf. also J. E. Gray, P. Z. S. 1853, p. 112.

† HAKLUYTUS POSTHUMUS OR PURCHAS HIS PILGRIMES, &c. By Samuel Purchas, B.D. London: 1624, vol. iii. p. 560.

‡ Letters from High Latitudes, pp. 387-389.

§ Seasons with the Sea-Horses, pp. 26, 27.

discouraged by the bad luck which has attended our efforts in the case of the larger marine Mammalia. Every person I have spoken with on the subject corroborates the account given by honest Master Welden of the "strange docilitie" of this beast; and that in a mere financial point of view the attempt would be worth undertaking is, I think, manifest. To the general public perhaps the most permanently attractive animals exhibited in our Gardens are the Hippopotamuses and the Seals. What, then, would be the case with a species like the Walrus, wherein the active intelligence of the latter is added to the powerful bulk of the former? There is also another consideration why we should make the attempt. In a few years it is probable that the difficulties of obtaining a live example of the Walrus will be much greater. Its numbers are apparently decreasing with woful rapidity. The time is certainly not very far distant when *Trichechus Rosmarus* will be as extinct in the Spitsbergen seas as *Rhytina gigas* is in those of Behring's Straits. I see no reason to doubt the assertion, or perhaps it would be safer to say the inference, that in former days Walruses habitually frequented the coasts of Finmark; in the sixteenth and seventeenth centuries they were certainly abundant about Bear Island: they are spoken of there, as "lying like hogges upon heaps" by the old writer I have before quoted; yet for the last thirty years probably not one has been seen there. Now they are hemmed in by the packed ice of the Polar Sea on the one side and their merciless enemies on the other. The result cannot admit of any doubt.

But to continue my story from this digression, which I hope, however, may not be without its use. On the 10th of August our two ships again joined company; and, finding it was useless attempting either to get up the Stor Fjord or sail further to the eastward, we again rounded the South Cape and made for the northward. The season, however, being now so far advanced, our pilot declined the responsibility of taking the yacht further north than Ice Fjord; and accordingly, after having to steer considerably to the westward to avoid the heavy ice which beset the coast about Horn Sound, we found ourselves, on the afternoon of the 14th, once more at our old anchorage in Safe Haven. Here we remained another week, most of our party finding plenty of occupation in deer-stalking; but I was not able to add much to my stock of zoological knowledge. The deer were now in magnificent condition, and nineteen were shot, making, with those obtained the week the yacht was there in July, a total of forty-seven. On the night of the 17th the salt water of the Haven was frozen over, and two days afterwards the sun set. On the morning of the 21st we weighed anchor, homeward-bound. On the 24th we spoke a Norwegian *jagt*, engaged in the fishing of *Scymnus borealis*, an example of which was hauled up just as we passed*.

* This fishery has of late years assumed considerable importance. The vessels employed in it mostly do not go so far north, but keep about midway between Bear Island and the North Cape of Europe. There they anchor in deep water with a light cable, which they cut if it comes on to blow suddenly. The Sharks are caught with a baited hook at the end of a very long line. As soon as one is

The same day we sighted Bear Island, which on our outward voyage we had not seen, owing to the fog; and on the 27th we reached Hammerfest.

It remains for me to add a few words on the Cetaceans we saw. I have already mentioned *Beluga catodon*, which we observed also on two other occasions. This is the only species of which I can speak definitely, though we certainly saw at least four others. Of these, the first was a large black Fin-backed Whale, noticed three or four times; the second a smaller animal, perhaps about thirty or forty feet long, of which some half a dozen came and played round the yacht on the 12th of August. In general form, especially in the *esocine* shape of the head, these corresponded very closely with the engraving given by Dr. Scoresby (Arctic Regions, vol. ii. pl. 13. f. 2) as that of *Balæna rostrata* (= *Balænoptera rostrata*, J. E. Gray); but I rather hesitate to refer them positively to that species, on account of their colour, which was apparently of a uniform light reddish brown. I had an excellent opportunity of observing these Whales, for they kept with us about a quarter of an hour, sometimes passing under the ship, and often coming up close alongside, within perhaps thirty yards. On the following day I saw a school of Grampuses, with extremely long and high dorsal fins; but this was the only occasion on which this species was noticed. Some kind of Porpoise, on the contrary, was seen more than once*. In addition to these Cetaceans, the Right Whale (*Balæna Mysticetus*) and the Narwhal (*Monodon monoceros*) are well known to inhabit the Spitsbergen seas. Mr. Malmgren, in his careful paper before alluded to, enumerates six or perhaps seven species of Whales, not reckoning a Porpoise. We therefore have seven or eight Cetaceans, seven Carnivores (including *Ursus maritimus*, on which I have no remark to make), and one Ruminant as the sum total of the Mammalian fauna of Spitsbergen. Without extending these notes by going into details, I may here state that I think the bird-fauna cannot be reckoned at more than twenty-seven species. We therefore have the singular result of a country, say as large as Ireland, where the number of Mammalian bears to the number of Ornithic species the ratio of 15 or 16 to 27.

hooked, he is hauled up on deck by a windlass, and beaten on the head until he is motionless. His liver, which alone is required of him, is then cut out; and, his entrails being fully inflated with air, his body is heaved overboard to float away quite clear of the vessel. The cause of this apparently wanton cruelty is alleged to be the difficulty of otherwise disposing of the carcass; for the fishermen say that if the animal were killed, they would not catch another Shark until the dead one was entirely eaten up by his brethren, a process that might involve a delay of some days.

* I feel very confident of the truth of this statement; but I find no mention made of any Porpoise in the Spitsbergen seas by either Scoresby or Malmgren. This fact I unfortunately had not noticed until my return home; so that (Porpoises being in general of so common occurrence on a sea voyage) I neglected to record, as I otherwise should certainly have done, the dates and localities of their appearance. It is of course possible that what I took to be Porpoises were only the young of some larger Cetacean; but I do not think this was the case.

MISCELLANEOUS.

Investigations on Eggs with a Double Germ, and on the Origin of Double Monsters in Birds. By M. C. DARESTE.

THE coexistence of two embryos upon a single vitellus, indicated by Wolf in the last century, has since been repeatedly noticed. The author considers that the facts observed, although not numerous, belong to two phenomena of very different nature, origin, and physiological starting-points.

Sometimes, during the first days of incubation, two distinct blastoderms, completely separated from each other, and each presenting its transparent area, are observed. Subsequently these blastoderms become united by the margins and form a single blastoderm, which, however, is the result of the fusion of two primitively distinct blastoderms. Each transparent area may then give origin to an embryo, and each embryo may envelope itself in its proper amnios. The two embryos thus remain completely separated, being only mediately united by the vitellus; a second mediate union may also be effected, subsequently to their formation, by the fusion of the vascular areas, where these meet.

In the second case there exists only a single blastoderm, and in this a single transparent area, which is remarkable, however, for its irregular form. The two embryos which are developed in this single but irregular area give origin to a single vascular area (which, however, is formed, at least partially, of the elements of two normal vascular areas), and they become enveloped by a single amnios.

The two embryos thus developed upon a common transparent area remain in some cases completely isolated, except as regards the indirect union effected by the vitellus. Then both of them may be sometimes constructed normally; sometimes one of them is imperfectly developed and forms an acephalous monster. In other cases the two embryos unite directly and produce a double monster; and this union may be either early or late.

The origin of these two modes of coexistence of two embryos upon a single vitellus is very evident. In the first case the egg contains two distinct cicatriculæ before incubation; in the second, only one. The physiological consequences of these two arrangements are very remarkable. It is no longer supposed that double monstrosity is the result of the fusion of two embryos developed upon distinct vitelli, and it is admitted that the coexistence of two embryos upon a single vitellus is the starting-point of all cases of double monstrosity. The author goes still further, and maintains that, for the formation of a double monster, the embryos must actually originate upon a single transparent area, or, in other words, in a blastoderm proceeding from a single cicatricula. But it remains to be ascertained why in some cases the two embryos are developed separately, whilst in others they form a double monster.

This question, moreover, is connected with another more general one. Is this single cicatricula, which gives origin sometimes to two distinct embryos and sometimes to two united ones, really simple

and similar to the ordinary cicatriculæ, or is it the result of the early fusion of two primarily distinct cicatriculæ or germs? Since M. Balbiani has shown how the germ is formed in the ovule, we may consider whether certain ovules may not contain a cicatrícula apparently simple, but formed by the fusion of two originally distinct germs. And the coexistence of two germs within a single ovule is proved by the coexistence of two separate cicatriculæ upon the same vitellus.

The author has recently observed an egg presenting a very singular arrangement, but which is explained by a combination of the two cases above described. In this there were two transparent areas upon a single blastoderm and in a single vascular area, the latter of a very abnormal form. One of the transparent areas was normal, and presented a normal embryo; the other, of an irregular form, presented two embryos, one normal, the other abnormal. This fact, although apparently very complex, may be very simply explained by the coexistence upon the same vitellus of two distinct cicatriculæ, one normal, the other formed by the fusion of two germs, and by the production of a single blastoderm from these cicatriculæ during incubation.—*Comptes Rendus*, March 20, 1865, p. 562.

On two Starfishes from Costa Rica. By E. VON MARTENS.

On the 16th January Dr. E. von Martens communicated to the Academy of Sciences at Berlin a description of two species of Starfishes from Costa Rica. The first of these is the *Oreaster armatus*, Gray, which is described as follows:—

1. *Oreaster armatus*, Gray, sp.

Body pentagonal, with strongly incurved sides; proportion of the radius of the disk to that of the arms as 1 to $1\frac{1}{2}$ nearly. Dorsal surface but little elevated. Ambulacral papillæ in two rows; on the inner plates three and more, rarely two, placed close together upon each plate; on each of the outer plates one larger papilla. The plates of the ventral surface are thickly set with globular granules, and bear on the middle of each a large cylindrical tubercle which is obtuse at the apex. The lower marginal plates belong entirely to the ventral surface: they are thickly set with globular granules, and bear in the middle of each a larger, conical, moderately acute spine, which is villous, like satin, and the narrowed flat base of which is surrounded, as by a wall, with the granules of the marginal plate itself. There are seventeen inferior marginal plates between the apices of each pair of arms; they are all nearly square. The superior marginal plates, which alone form the margin, are twice as high as their breadth in the middle of the space between two arm-tips; towards the latter they become broader in proportion, and finally nearly square. Their number between each pair of arm-tips is fourteen. They are beset with granules, in the same manner as the inferior marginal plates, and bear a precisely similar spine in their middle; many of them, however, are destitute of the spine and even of every

trace of its insertion, whilst on all the inferior plates, when the spine has been lost, the place to which it was attached is distinctly recognizable. The marginal plates all fit accurately together without intervening granules. The dorsal surface is covered with smaller, polygonal, convex plates, also densely granulated; the granules resemble those of the marginal plates, and are smaller and less elevated than those of the ventral surface. The back of each arm forms a blunt radial elevation (but not a sharp keel), along which there is a simple series of spines, formed like those of the marginal plates, but larger. Near the middle, the five elevations unite to form an annular wall, which encloses a somewhat depressed central surface. A few larger spines stand on this central surface, but without being definitely arranged in any of the five radial rows. Lastly, one larger spine stands in the middle line of each interrarial space, near the margin. No pedicellariæ are to be found on the single specimen.

Radius of the disk 48, of the arms 69 millim. Height of the dry specimen, without the spines, 18 millim.

Islas los Negritos, in the Gulf of Nicoya, Costa Rica; collected by M. Hoffmann in 1857, and afterwards sent to the Berlin Museum. Colour, when alive, tile-red, according to Hoffmann's notes.

In the 'Annals and Magazine of Natural History,' vol. vi. p. 277 (1840), Dr. Gray briefly described a new species under the name of *Pentaceres armatus*; he gives as its habitat Punta Santa Elena. He founds upon it a peculiar subgenus, *Nidorellia*, which he characterizes as follows:—"Back regularly convex, formed of flat granular ossicula, with a blunt mobile spine on the centre of each ossiculum below; arms short and broad."

Müller and Troschel were not acquainted with this species, and under the name of *Oreaster armatus* they merely give a German translation of Gray's words, in which, however, they omit the word "below," evidently because they could not understand Gray's extremely obscure mode of expression without comparison with a specimen. Hence must have originated the misconception which represents it as if each plate on the dorsal surface bore a spine, which, however, is not the case, as I have ascertained from the original specimen in the British Museum. Dujardin and Hupé (Hist. Nat. des Zoophytes Echinodermes, p. 387) retranslate the above translation into French, without adding anything new, except an error and a fresh cause of error. In the first place, of the words "the inferior marginal plates and the three last superior ones, &c., with spines," they have overlooked the little word "superior," and translated them "les plaques marginales inférieures et plus particulièrement les trois dernières." In the second place, they give as the habitat simply "Sainte-Hélène," from which every one would at once be led to think of the well-known island in the South Atlantic Ocean, and not of the Cape on the west coast of Ecuador, not far from Guayaquil. Under these circumstances I considered it by no means unnecessary to give a detailed description of the species after the fashion of those drawn up for other species by Müller and Troschel, even without the particular circumstance which I have now to mention, and to which

my attention was called by Professor Beyrich. The larger spines along the dorsal line of the arms in the dried specimen are partly erect and partly depressed, which certainly could arise only from local differences in the shrinking during the desiccation of the specimen, but still produces an impression that the spines must have been moveable during life—a view which is further borne out both by the smoothness of the base of the spine and by that of the surface to which it is attached, although this is surrounded by granules, and from it even the dry spines may be very easily detached. Gray also describes the spines as mobile.

In living *Oreasters* of the Indian Archipelago, however, I have never noticed any mobility of the spines independent of their point of attachment, but I ascribed their convergence after death to the locally unequal shrinking of the entire surface; nevertheless in these Indian species I do not now find the spines so distinctly differentiated from their point of attachment as in the Central American species.

2. *Astropecten cœlacanthus*, n. sp.

Five arms; radius of the disk to that of the arms about as 1 to 3. Marginal plates twenty-four on each arm. Ambulacral papillæ in several rows, the outer ones larger, all somewhat compressed and obtuse. From the scaly covering of the ventral plates larger flat spines project everywhere, and near the margin especially these group themselves in rows parallel to the margin, consisting of three spines for each inferior plate; on the margin itself there is on each of these plates one spine. These marginal spines are small and flat in the interbrachial angles, as also at the apex of the arms; in the middle of the arms they are large, flat, slightly sabre-shaped, and bent round on the free margins in such a manner as to present a spoon-like cavity, directed downwards and backwards (that is to say, towards the interbrachial angle). The superior marginal plates are twice as deep as broad, densely granulated, with a few (2-4) larger tubercles, which stand in a transverse row, and of which the innermost (superior) especially are never wanting. The back, arms, and disk within these marginal plates are thickly set with paxillæ; in the middle of the arms this space is scarcely twice as broad as the height of one of the superior marginal plates.

Radius of the disk 17, of the arms 49 millim.; height in the middle 8 millim. Captured and sent with the preceding species.—*Monatsber. der Akad. der Wiss. zu Berlin*, January 1865, p. 56.

Occurrence of *Calluna vulgaris* in Newfoundland.

Mr. Murray, late of the Geological Survey of Canada, and now engaged in a survey of Newfoundland, has brought to Montreal specimens of this plant, which were collected by Judge Robinson on the east coast of Newfoundland, near Ferryland (lat. 47°, long. 52° 50'), and which are stated to be from a small patch of the plant not more than three yards square.—*Silliman's Journal*, March 1865.

On a new Species of Bat from Zambesia.

By Dr. J. KIRK.

NYCTICEJUS NIDICOLA.

Fur brown, the base of the hairs blackish; beneath yellowish. Ears ovate, acute, with a well-developed rounded process at the front part of the outer or lower edge. Tongue linear lanceolate, acute, rather more than half the length of the ear. Face depressed, bristly. Wings elongate, thin, bald, rather hairy above and below close to the body; forearm-bone nearly $1\frac{1}{2}$ inch long; the thumb compressed, rather elongate, slender, of a single joint. Tail as long as the body. The interfemoral membrane very large, broad, with nearly regular, almost parallel transverse muscular bands, which are hairy on the upper and lower surface. The spur elongate, strong, nearly as long as the fore leg and foot; the spur and the end of the membrane fringed with short, rather rigid hairs. The legs rather elongate; the lower part of the thigh slender; the shank slender, not quite half the length of the arm-bone; the toes moderate, slender, compressed, covered with short adpressed hairs.

Expanse of wings 10 inches, of forearm-bone 1.5 inch, of fore leg 8 inches, of foot 3 inches, of spur $9\frac{1}{2}$ lines.

Shupanga, near the Zambesi.

Four specimens were obtained; they had taken possession of the nests of Weaver-birds (*Euplectes*). Having accidentally found a pair in one of these hanging nests, others were soon discovered in similar positions near by.—*Proc. Zool. Soc.* Dec. 13, 1864.

Preservation of Starfishes with their Natural Colours.

By A. E. VERRILL.

Starfishes may be dried, so as to retain their natural colours almost unimpaired, by immersing them in alcohol of moderate strength for about a minute, or just long enough to destroy life and produce contraction of the tissues, and afterwards drying them rapidly by artificial heat. The drying is best effected by placing them upon an open cloth stretched tightly upon a frame and supported a few feet above a stove. Care should be taken not to raise the heat too high, as the green shades change to red at a temperature near that of boiling water. By this process I have succeeded in preserving the delicate shades of red, purple, and orange of the species found on the coast of New England, including *Solaster papposus*, *S. endeca*, *Cribella*, *Asteracanthion pallide*, *A. littoralum*, and various other species, specimens of which are preserved in the Museum of Yale College.

The same process is equally applicable to Echini and Crustacea.—*Silliman's Journal*, March 1865.

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[THIRD SERIES.]

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XLVI.—*On a new Form of Alternation of Generations in the Medusæ, and on the Relationship of the Geryonidæ and Æginidæ.* By Dr. ERNST HÆCKEL*.

THE fact of the alternation of generations between the Medusæ or Discophorous Acalephs and the Hydroid polypes, which when first made known excited so much attention, and was doubted by so many, has in the two last decennia been proved, by widely extended investigations, to be so generally diffused in the class of the Hydromedusæ, that the cases of simple homogonic reproduction in this class of animals appear to constitute rare exceptions. At the same time, an unexpected abundance of the most various modifications has been discovered, rendering the reproductive conditions of these animals the most interesting in the whole organic world. But that this abundance is still by no means exhausted is proved by almost every thorough investigation of a particular group of Medusæ. Thus the careful investigations which I had the opportunity of making during a long period last spring, in the Gulf of Nice, upon a large *Geryonia*, and of continuing up to the present time upon well-preserved preparations, have led me to the discovery of a new form of alternation of generations, which differs so much from all other known forms that it is certainly permissible to give a short preliminary account of it here.

The *Geryonidæ* form a family of the Craspedota or *Medusæ cryptocarpæ*, which, although small, is strikingly distinguished by many remarkable structural characters. The family may be divided into two subfamilies—the *Liriopides* and *Carmarinides*—of which the former (*Liriope*, *Glossocodon*) resemble most of the other Medusæ in the *quadruplicity* of all their organs, whilst the

* Translated from the 'Monatsbericht der Akad. der Wiss. zu Berlin,' Feb. 1865, p. 85, by W. S. Dallas, F.L.S.

latter (*Carmarina*, *Geryonia*) are distinguished by having all their organs *sextuple*, and by their considerable size. With regard to the conditions of reproduction in these animals, scarcely anything has hitherto been known. According to a short notice published by Krohn* in 1861, this most meritorious naturalist had, as early as 1843, observed a sexually mature female specimen of *Geryonia proboscidalis*, of which "the extremity of the peduncle, reaching down freely into the stomachal cavity, appeared thickly beset with buds in various stages of development. In the less developed buds only the umbrella and peduncle could be distinguished; the further advanced ones had developed not only the six tentacles, but also the marginal corpuscles." This isolated observation, which seems to have attracted but little notice, might have led, had it been followed out, to the discovery of the wonderful phenomenon which will be described immediately.

Besides this we have hitherto had only the admirable description of a singular metamorphosis observed by Fritz Müller, in 1859, in the larva of a quadruplex Geryonide of the Brazilian coast†. The origin of this larva, which was captured swimming freely in the sea, and which gradually became converted into the sexually mature *Liriope Catharinensis*, remained unknown. Hence it has been generally believed, although supported by no direct observation, that the *Geryonidæ*, like the *Trachynemidæ* and *Æginidæ*, are propagated homogenically, and without any alternation of generations.

The *Geryonidæ* which I had the opportunity of continuously observing at Nice belong to two very different species. The smaller species, *Liriope* (*Glossocodon*) *eurybia*, which occurs there in abundance, is quadruplex, and has an umbrella of 8–10 millim. in diameter. This species undergoes a metamorphosis very similar to that of *Liriope Catharinensis* described by Fritz Müller. The second, much larger and rarer species, which I have named *Geryonia* (*Carmarina*) *hastata*, is sextuplex, and attains a diameter of 50–60 millim.

In the sextuplex *Geryonidæ* a metamorphosis has not hitherto been observed. I have, however, been able to trace this in its whole course in numerous larvæ of *Geryonia hastata* captured in the open sea. The metamorphosis of the sextuplex *Carmarinides* takes place on the whole in accordance with the same laws as that of the quadruplex *Liriopides*, of course with the difference that all the organs make their appearance to the number of six or a multiple of six, instead of four or a multiple of four. The

* Wiegmann's Archiv, xxvii. 1. p. 169, note. See Annals, ser. 3. vol. ix. p. 8 (1862).

† *Ibid.* xxv. 1. p. 310.

globular larva first of all developes six solid radial subsidiary tentacles, then six solid interradial tentacles, and afterwards six interradial sensory vesicles. Then only do the six hollow radial primary tentacles make their appearance, and lastly, after these, the six radial sensory vesicles. The first twelve solid tentacles are then lost, and only the last six, the hollow radial primary tentacles, remain. At the same time the long stomachal peduncle, which was at first entirely wanting, is developed.

These sextuple larvæ, the metamorphosis of which into the fully-developed *Geryonia hastata* may be traced through all its stages, are probably the products of sexual reproduction. But the same animal also developes young Medusæ asexually, and, indeed, *by gemmation in the interior of the digestive stomachal cavity*; and these have a perfectly different form and structure. These Medusoid-buds are probably the same that Krohn saw on one occasion. But they are not, as stated by him, *sextuple*, nor do they become developed into a *Geryonia*; but they are *octuple*, and are developed into a totally different Medusa, very probably into a species of the family *Æginidæ*, described by me as *Cunina rhododactyla*.

This gemmation, which is exceedingly remarkable, both on account of its locality and of its heterogeneous product, occurs only in the stomachs of sexually mature animals, and in both sexes. I was able to examine twenty-three individuals of *Geryonia hastata* with regard to the conditions of this phenomenon. Of these no less than nine had the stomach reduced to a stump, or in course of reproduction. Of the other fourteen, seven showed a long spike of closely united eight-rayed buds in the stomach; of these seven animals three were males, and four females, all with perfectly mature sexual products in the genital leaves. The number of buds in the stomach of each animal varied from twenty to nearly a hundred. The buds were seated close together, with the vertical surface of the umbrella (the aboral pole) attached to a long cylindrical process which was fixed to the base of the stomach. This process is nothing but the long dagger-like prolongation of the stomachal peduncle, which, in *Carmarina*, as in *Glossocodon*, projects freely into the stomachal cavity, and in non-gemmiparous animals is often protruded from the mouth, and seems to subserve the function of a tongue. In two of the largest *Geryonia* I counted the buds attached to the tongue and forming with it a thick cylindrical spike, which hung down freely in the middle of the campanulate stomach like the clapper of a bell. One spike was composed of seventy-one, the other of eighty-five buds. Young and old buds, in the most various stages of development, are seated indiscriminately together.

The most developed, largest, and oldest buds have a thick disciform umbrella, rather more than 1 millim. in diameter, and are quite different both from the full-grown *Geryonia hastata* and from the youngest larvæ of that species, which also had umbrellas 1 millim. in diameter. *Geryonia hastata* develops all its organs in *sixes*; the buds, on the contrary, in *eights*. During its metamorphosis *Geryonia* develops three circles, each of six tentacles, the tentacles of each circle being quite different from those of the other two. The Medusa-buds, on the contrary, bear eight similar tentacles affixed in deep notches of the margin of the umbrella, half on the dorsal surface of the umbrella. Of the eight marginal lobes, which project far between the notches, each bears at its apex a sensory vesicle, which projects freely upon a short peduncle. In *Geryonia*, on the contrary, the margin of the umbrella is not divided into lobes, and the twelve sensory vesicles are completely enclosed within the gelatinous substance of the margin. Equally important differences are presented by the gastrovascular apparatus of the mature *Geryonia* and that of the buds produced in its stomach. In the former the small campanulate stomach is seated upon a long solid gelatinous peduncle, in the surface of which six separated canals, originating from the base of the stomach, ascend to the umbrella, on reaching which they are bent round, and run in the subumbrella as radial canals to the margin of the disk. Here the six canals are united by a circular annular vessel, from which seven cæcal centripetal canals are given off in a radial direction inwards between each pair of radial canals. In the buds, on the contrary, there is a perfectly simple, rather long, cylindrical stomachal tube, which leads into eight broad and flat radial sacs reaching to the base of the tentacles. These stomachal sacs are united by an annular vessel, which runs along the margin of the eight lobes.

That the singular buds which sprout from the tongue of the *Geryonia* within the stomachal cavity cannot themselves be developed into *Geryoniæ* is perfectly evident. By no metamorphosis could this bud, which is so completely different in the fundamental structure of its body, revert directly to the form of the parent animal. Nor, from its whole structure, can it be converted into a quadruplex Geryonide. Nothing remains, therefore, except to seek the further stages of development of the buds in some other family of Medusæ. There is, however, only a single group of Medusæ which shares the above-mentioned very characteristic peculiarities of structure with the buds of *Geryonia*. This is the family of the *Æginidæ*. A species of this family, *Cunina rhododactyla*, occurs in great quantities in company with *Geryonia hastata*; indeed I have captured this *Cu-*

nina only on those days when the *Geryonia* also appeared in the Gulf of Nice, but then always accompanying the latter in great quantities.

The youngest individuals of *Cunina rhododactyla* that I have observed, of which the umbrella was 3 millims. in diameter, agreed in all essential particulars so closely with the oldest observed *Geryonia*-buds of 1 millim. diameter, that I can no longer doubt the identity of the two forms. As in the bud of the *Geryonia*, the thick disciform umbrella is divided at the margin by eight deep notches into the same number of lobes, each of which bears at its apex a pedunculate free sensory vesicle. Eight similar tentacles are attached in the notches. The simple unpedunculated stomach gives off from its circumference eight flat and broad radial sacs, which reach to the base of the tentacles, and are there united by a narrow annular vessel which runs along the border of the marginal lobes. The only difference, besides the smaller size and plumper form of the stomachal buds of *Geryonia*, that I can find between the oldest of these buds and the youngest individuals of *Cunina* consists in the fact that the tentacles of the latter are more slender and longer, and, on the other hand, the stomach is flatter and shorter—differences which would, no doubt, disappear by the observation of the intermediate age 2 millims. in diameter.

I have also been able to ascertain the further development of *Cunina rhododactyla* to full sexual maturity. It consists essentially in the gradual increase of the number of similar segments composing the body from eight to sixteen, a new segment being inserted from time to time between those previously existing. The oldest animals have an umbrella 10–11 millims. in diameter, and possess sixteen tentacles, sixteen stomachal sacs, sixteen marginal lobes, and a great but indeterminate number (between 50 and 100) of sensory vesicles. The latter increase in a very irregular manner, so that the different marginal lobes of one and the same animal bear from four to eight vesicles. The sexual products are developed in the lower wall of the stomachal sacs, from its epithelium.

From all that has been stated, it appears to me to be no longer doubtful that the octoradiate buds which sprout from the tongue of the sexually mature sexradiate *Geryonia* (*Carmarina*) *hastata*, within its stomachal cavity, are really developed directly into the sexually mature animal of *Cunina rhododactyla*. Should this supposition (which I cannot but regard as a certainty) be confirmed, it requires nothing further to show that we have here an exceedingly wonderful and perfectly and fundamentally new form of the alternation of generations, if indeed we may apply that name to this singular process. It might better be called

heterogonism or *allœogenesis*. It is not, as in the other multifarious forms of the alternation of generations, a sexual and an asexual form—a Medusa and a polype—that stand in a reciprocal genital relation to each other; but we find here that a perfectly developed Medusa, evolved by metamorphosis from a larval form, at a time when its generative organs furnish mature products (from which probably the above-mentioned larvæ are produced), produces young Medusæ, asexually, by formation of buds in its stomachal cavity, and these are developed into a Medusa-form perfectly distinct from their parent, and which in its turn becomes sexually mature.

What, then, becomes of the sexual products of *Cunina*? How does this octoradiæ Æginide revert to the sexradiæ Geryonide? Or does it only propagate in an Æginide form? or are the larvæ of the *Geryonia* produced sexually or asexually from the *Cunina*? But, also, what becomes of the sexual products of the *Geryonia*? Does the *Cunina* also propagate asexually? or are there Hydroid polypes which establish the union between the two Medusoid forms, which appear to be so widely separated? These and many other questions force themselves upon us in the presence of this wonderful fact, without our seeing at present any way of escaping from this labyrinth. But I hope shortly to be able to take these questions in hand again at the Mediterranean, and to bring them to a solution.

The paradoxical nature of the demonstrated relation might well lead us to a suspicion of *parasitism*. But, leaving out of consideration other pertinent reasons to the contrary, this is at once contradicted with certainty by the fact that the development of the *Cunina*-buds upon the surface of the tongue of the *Geryonia* may be traced through all stages from its first commencement. The first foundation of the sprouting bud is nothing but a small disciform thickening of the epithelium of the tongue. This homogeneous cell-growth is then differentiated into two distinct laminæ—a lighter ectoderm and a darker endoderm. In the latter is produced a small round cavity, the first trace of the stomachal cavity, which then grows out into the above-mentioned cylindrical stomachal tube, whilst the disk is differentiated into eight segments.

The *Æginidæ* and *Geryonidæ* have hitherto passed as perfectly distinct families of Medusæ. The numerous peculiarities which so strongly characterize both the external form of the body and the interior structure of the *Æginidæ* appear, indeed, to remove this family far from all others. Quite recently, in fact, two distinguished naturalists have even separated the *Æginidæ* altogether from the great section of the Craspedota (*Cryptocarpæ*). Fritz Müller has placed them as a third distinct primary group

between the two other groups of the Craspedota and Acraspeda. Agassiz, on the other hand, has actually transferred them to the Acraspeda (*Phanerocarpæ*).

A very careful anatomical and histological investigation which I made, after becoming acquainted with the genetic relations just described, of two *Æginidæ* (*Cunina rhododactyla* and *C. albescens*) and two *Geryonidæ* (*Carmarina hastata* and *Glossocodon Eurybia*), led me to the surprising result that these two families present a far more essential agreement in internal structure than could be supposed from the remarkably different external form of the body. I shall only mention, in conclusion, the most important agreements, in a few words. It is regarded as the principal character of the *Æginidæ* that they have no annular vessel like the other Craspedote Medusæ, but merely blind sacs which issue from the circumference of the stomach. But these sacs are nothing but greatly dilated radial canals; and, in fact, they are united at the base by an annular vessel, which runs along the margin of the mantle, and has hitherto escaped the notice of observers merely on account of its very small dimensions. The intimate structure of this annular vessel is exactly the same as in *Geryonia*. As in that genus, so also in *Cunina*, there is, immediately beneath the annular vessel, a slender cylindrical or semicylindrical cartilaginous band, from which issue a number of centripetal and likewise cartilaginous bands, which rise in a radial direction for some distance in the outer surface of the margin of the mantle, and give support to it. Moreover, in *Cunina* as in *Geryonia*, there is a fine nervous ring on the margin of the umbrella, contiguous internally to the insertion of the velum, superiorly to the lower margin of the annular vessel, externally to the gelatinous substance of the mantle, and inferiorly to the cartilaginous ring. The formation of the sexual products in flat, leaf-like, saccular dilatations of the radial canals is also exactly accordant in both the families of *Æginidæ* and *Geryonidæ*, and very different from that occurring in all other Medusæ.

But the anatomical relation between *Cunina* and the larva of *Geryonia* is far greater than between the mature animals of the two genera. These two forms possess in common especially the characteristic firm habit of the umbrella and the peculiar structure of the solid, rigid tentacles, which are wanting in the mature *Geryonia*. The primary mass of these tentacles is formed by a cartilaginous cylinder, which is covered by a muscular tube; over this is an epithelium, in which urticating cells are here and there developed. The stomach of the young larva of *Geryonia* is also a very shallow sac, as in *Cunina*. The most essential anatomical difference between the *Geryonidæ* and

Æginidæ is to be found in the position and structure of organs of sense (marginal vesicles), which are certainly very different in the two families (and also as regards their intimate structure). In the *Æginidæ* the sensory vesicles are situated freely on the outer margin of the umbrella, and are elevated upon short peduncles. In the *Geryonidæ*, on the contrary, they are enclosed in the gelatinous mass which forms the lowest margin of the mantle, and each vesicle is seated here upon a ganglion-like enlargement of the nervous ring. Perhaps the demonstration of this close anatomical affinity of the *Geryonidæ* and *Æginidæ* may serve, at least in one respect, to make the genetic connexion of the two families above described appear less enigmatical.

Finally, I may remark that I had the pleasure of bringing the above-described remarkable phenomena under the immediate notice of one of the first authorities upon Medusæ, my friend Professor Gegenbaur, and that he was convinced of the correctness of my observations and the justness of the conclusions founded upon them.

XLVII.—*Notices of British Fungi*. By the Rev. M. J. BERKELEY, M.A., F.L.S., and C. E. BROOME, Esq.

[Continued from p. 404.]

[Plates XV., XVI., XVII.]

1063. *Peziza* (*Geopyxis*) *carbonaria*, Alb. & Schw. p. 314.
On burnt ground. Ascot, C. E. Broome, 1863.
A charming addition to our list.

PLATE XV. fig. 15. *a.* ascus with paraphysis, magnified; *b.* sporidia, more highly magnified.

1064. *P.* (*Humaria*) *Wrightii*, Berk. & Curt. Cupulis hemisphæricis, demum planis, coccineis, extus furfuraceo-granulatis; sporidiis globosis, l. subglobosis, junioribus lævibus, adultis echinulatis.

On trunks of trees covered with *Hypnum serpens*. Bodelwyddan, Flintshire, March 1864.

Sporidia .00045–.0006 inch in diameter; paraphyses slender, branched.

The Texas plant is just the same, and agrees exactly in habit.

PLATE XV. fig. 16. *a.* asci, magnified; *b.* paraphysis; *c.* sporidia, more highly magnified.

1065. *P.* (*Sarcoscyphæ*) *theleboloides*, A. & S. p. 321, t. 12.
On spent Hops. Batheaston, Ilford, Essex, C. E. Broome and W. W. Saunders.

Cup at first obovate or subcylindrical, concave and expanded when mature, of a bright-orange colour within, beset externally with delicate, erect, white hairs, which are hyaline under the microscope, and seated at first on a delicate white subiculum, which disappears as the plant advances to maturity and the cups become crowded. Asci linear.

PLATE XV. fig. 17. *a.* hair from outside of cup; *b.* ascus; *c.* paraphysis; *d.* sporidia, .0005 inch long, .00025 wide.

1066. *P.* (*Sarcoscyphæ*) *pygmæa*, Fr. Syst. Myc. vol. ii. p. 79. Cupula concava, demum plana, aurantiaca, extus cum stipite crassiusculo tomentoso, pallida; sporidiis minoribus fusiformibus, enucleatis.

On dead twigs of *Ulex*, buried in the sandy soil. Ascot, Nov. 1863, C. E. Broome. Fries's plant was found in June, on fir.

Cup 3–6 lines broad. The stem varies in length according to the depth at which the twig is buried. Sporidia .0005–.0006 inch long. Hymenium proliferous, as in *Cyphella Curreyi*.

This seems to agree so closely with the plant of Fries, that we do not like to separate it. His species, which he found once only, was possibly in a young state.

PLATE XV. fig. 18. Asci, magnified; *b.* sporidia, ditto.

1067. *P.* (*Dasyscyphæ*) *diplocarpa*, Curr. Linn. Tr. vol. xxiv. p. 153, figs. 30–33.

Joyden's Wood, Dartford, Nov. 8, 1862, C. E. Broome.

Remarkable for the solitary stylospores which crown the paraphyses.

1068. *P.* (*Mollisia*) *auricolor*, Blox. MS. Mollis, subgelatinosa, aurantiaca; cupula marginata e strato tenui hyalino filamentoso oriunda; sporidiis angustis.

On the under side of a fallen tree. Gopsal, Rev. A. Bloxam.

Cups with a broad raised margin, springing from delicate radiating hyaline interwoven hairs.

The evident affinity of this species to *P. vinosa* induces us to place it in *Mollisia* rather than *Tapesia*.

1069. *P.* (*Mollisia*) *hepatica*, Batsch, fig. 138. Sessilis, concava, vinoso-badia, extus granulata; margine dentibus triangularibus cincto; paraphysibus septatis, articulis inflatis; sporidiis ellipticis, lævibus.

On the ground, beneath rabbits' dung, more rarely on the dung itself or surrounding mosses and twigs. Bowood, Bathford Down, Wiltshire, Jan. 1864, C. E. Broome. (Rab. Fung. Eur. Exs. no. 612.)

Gregarious; when young, subglobose and closed, then concave and flattened, 1–2 lines broad, of a watery consistence; paraphyses septate, the joints more or less swollen or inflated.

Asci linear; sporidia elliptic, uniseriate, hyaline, even, $\cdot 001$ inch long, $\cdot 0005$ broad.

PLATE XV. fig. 19. *a.* asci with paraphyses, magnified; *b.* sporidia, more highly magnified.

1070. *P.* (Mollisia) *Dematiicola*, n. s. Gregaria, minutissima; cupula hemisphærica, aquose umbrina, floccis longis hyalinis ciliata; disco cinereo; ascis brevioribus; sporidiis subcymbiformibus, hyalinis.

On dead wood, nestling amongst the flocci of some *Helminthosporoid* Fungus; but whether at all related to it, or not, we cannot say.

This very beautiful, though minute, species has a mixed resemblance to an *Excipula* and such *Ascoboli* as *A. ciliatus*.

PLATE XV. fig. 20. *a.* Ascus with bristles, magnified; *b.* sporidia, more highly magnified.

1071. *P.* (Calycina) *minutissima*, Batsch, fig. 143 (*P. Helminthosporii*, Blox. MS.). Albida; cupulis obovatis, substipitatis; margine incurvo; hymenio concavo; ascis clavatis, elongatis; sporidiis fusiformibus, 4-septatis, articulis tumidiusculis; paraphysibus filiformibus.

On *Helminthosporia*. Twycross, Rev. A. Bloxam. Batheaston, Jan. 1864.

Pallid; cups clavate, substipitate, margin incurved; sporidia $\cdot 0014$ inch long, quadrisepate.

This is undoubtedly the plant of Batsch, and very interesting from the marked character afforded by the sporidia.

PLATE XV. fig. 21. *a.* Ascus with paraphysis, magnified; *b.* sporidia, more highly magnified.

1072. *P.* (Mollisia) *Browniana*, Blox. MS. Cupula hemisphærica, sessili, cornea; margine pallidiore, ciliato; disco pallido; sporidiis breviter fusiformibus, hyalinis.

On dead stems of *Epilobium hirsutum*. Twycross, Rev. A. Bloxam.

Allied to *P. lacustris*. That in Fr. 'Sci. Suec.' no. 173 has sporidia $\cdot 0008$ inch long, uniseptate; that of Desm. no. 1064 has sporidia $\cdot 0006$ inch long; while *P. lacustris* from Mr. Currey has sporidia $\cdot 0005$ – $\cdot 0006$ long. The sporidia in Mr. Bloxam's plant are $\cdot 00045$ long. The colour is paler, and, when perfect, the ciliated margin, which consists of delicate, flexuous, more or less interwoven hairs, is characteristic.

1073. *P.* (Mollisia) *lacustris*, Fr. Sc. Suec. no. 173.

On dead stems of aquatic plants. F. Currey.

1074. *Helotium luteolum*, Curr. l. c. p. 153, figs. 11, 12, 18.

On gorse. Paul's Cray Common, Kent, May 31, 1862, F. Currey.

1075. *H. aquaticum*, Curr. l. c. p. 154, fig. 19.

On a fragment of stick in water. Paul's Cray Common, May 31, 1862.

1076. *Rhizina undulata*, Fr. Obs. i. p. 161; Intell. Obs. no. 25 (cum icone); Curr. l. c. p. 493, tab. 51. figs. 7-9.

Ascot, on sandy banks where the heath had been burnt down, in great abundance. First observed by the Rev. G. H. Sawyer.

Some of the specimens have a raised yellowish margin, as in *R. lævigata*; but this vanishes with age.

1077. *Patellaria* (*Mollisia*) *olivacea*, Batsch, El. fig. 51 (*Rhizina nigro-olivacea*, Curr. Linn. Tr. vol. xxiv. p. 493, tab. 51. figs. 10-12).

On rotting willow. Batheaston, C. E. Broome.

It runs over the wood in an irregular manner, like the thallus of a *Peltidea*. In its young state it is truly *Peziza*-like and very beautiful.

PLATE XV. fig. 22. *a a*. Asci with paraphyses, magnified; *b*. paraphyses bearing irregular conidia, ditto; *c*. sporidia, more highly magnified.

1078. *P. atro-vinosa*, Blox. MS.; Curr. l. c. p. 155, t. 25. f. 31. Gopsal, Rev. A. Bloxam.

1079. *P. aquatica*, Curr. l. c. p. 155, tab. 25. fig. 23.

Pond at St. George's Hill, Weybridge; Paul's Cray Common, May 1862, F. Currey.

1080. *P. palustris*, Curr. l. c. fig. 35.

On dead rushes in water. Paul's Cray Common, May 31, 1862.

1081. *Ascobolus viridis*, Curr. Linn. Tr. vol. xxiv. p. 154.

On clay. Hanham, Oct. 15, 1861; Leigh Wood, Clifton, Messrs. Currey and Broome.

The enormous increase of species in this interesting genus is mainly due to the researches of the Messrs. Crouan. They are wrong in saying that no one had observed the amethyst tint of the sporidia in *Ascobolus furfuraceus* before them. It is recorded in the 'English Flora,' published more than twenty-five years since. As the characters of the species depend so much on the sporidia, we think it useful to give figures from original sketches in most of the British species.

1082. *A. Jungermanniæ*, B. & B. (*Peziza Jungermanniæ*, Nees).

On *Jungermanniæ*. Jedburgh, A. Jerdon.

Asci slightly clavate, at length projecting; sporidia elliptic, .0006 inch long, sometimes rather irregular, of an intense verdigris-green when fresh, as are also the clavate-tipped paraphyses.

PLATE XVI. fig. 23. *a*. Paraphyses, magnified; *b*. asci, ditto; *c, d*. sporidia, more highly magnified.

**A. testaceus* (*Helotium testaceum*, B. Outl. p. 372).

This species, which was originally found on old sacking and

other manufactured hemp or flax, occurs on rabbits' dung in the West of England, C. E. Broome.

The asci project in good fresh specimens; and the habitat indicates an *Ascobolus* rather than an *Helotium*.

PLATE XIV. fig. 5. *a.* Ascus with paraphyses, magnified; *b.* sporidia, more highly magnified.

1083. *A. denudatus*, Fr. Syst. Myc. vol. ii. p. 164.

On the ground, attached to little roots. Marlborough Forest, Oct. 15, 1863, C. E. Broome.

Sporidia $\cdot 0007$ – $\cdot 0008$ inch long.

PLATE XVI. fig. 24. *a.* Ascus with paraphysis, magnified; *b.* sporidia, more highly magnified; *c.* epispore, ditto.

**A. vinosus*, B. Engl. Fl. v. p. 209.

Stylospores occur in this species occasionally at the tips of the paraphyses—a circumstance exactly analogous to one observed by us in a Lichen. (See Intr. to Crypt. Bot. p. 391, fig. 80 *d.*)

PLATE XVI. fig. 25. *a.* Ascus, magnified; *b.* sporidia, $\cdot 0006$ – $\cdot 0008$ inch long, more highly magnified; *c.* paraphysis with stylospores, ditto; *d.* stylospores fallen off, $\cdot 0007$ long, ditto.

**A. ciliatus*, Schm.

PLATE XIV. fig. 7. *a.* Plant, magnified; *b.* one of the cilia more highly magnified; *c.* asci with paraphysis, magnified; *d.* sporidia, more highly magnified.

1084. *A. depauperatus*, n. sp. Cupulis minutis appianatis e pallido vinosis; ascis brevibus; sporidiis obtuse fusiformibus, lurido-violaceis, lævibus; paraphysibus leviter incrassatis.

On dung of sheep, horse, and deer. Spye Park, Bathford, Hanham, &c., C. E. Broome.

Cups minute, not exceeding one-hundredth of an inch in diameter, yellowish when young, becoming vinous, but sometimes, when old, losing their purplish tint; sporidia, as in *A. vinosus* and some others, collected in a distinct sac, $\cdot 0004$ – $\cdot 0005$ inch long by $\cdot 00025$ wide, which is only half the dimensions of those of *A. vinosus*, the cups of which, moreover, are many times as large. It does not agree with any of Crouan's species.

PLATE XIV. fig. 6. *a.* Ascus with paraphysis, magnified; *b.* sporidia, more highly magnified.

1085. *A. Crouani*, Cooke, in Seem. Journ. of Bot. May 1864. (*A. miniatus*, Crouan.)

The sporidia, as represented by Mr. Cooke, are very young. As they advance to maturity, they are first verrucose, then beautifully reticulate, like the sporidia of some truffles.

PLATE XVI. fig. 26. *a.* Ascus with branched paraphyses, magnified; *b.* sporidia in a young stage of growth; *c.* more advanced, $\cdot 0005$ inch in diameter, more highly magnified.

**A. glaber*, P. Obs. 1, t. 4. f. 7.

PLATE XVI. fig. 27. *a.* Ascus, magnified; *b.* paraphysis, ditto; *c.* sporidia, '0005 inch broad, '0009–'001 long, more highly magnified; *d.* ditto swollen by rain, ditto.

Mr. Cooke's figure of the sporidia is not correct. The reticulation is by no means so uniform.

**A. carneus*, Pers. Syn. p. 676.

Asci in our specimens only '0012 inch long. They are more than twice as long in *A. granuliformis*. Unfortunately, we can find no perfect sporidia.

PLATE XVII. fig. 29. Asci and paraphyses, magnified.

*1085. *A. cinereus*, Crouan, in Ann. des Sc. Nat. sér. 4. vol. x. p. 194, fig. D.

Batheaston, C. E. Broome.

PLATE XVII. fig. 30. *a.* Ascus with paraphysis, magnified; *b.* tip of ascus and paraphysis, more magnified; *c.* sporidia, '0009 inch long, '0004 wide, ditto.

1086. *A. granuliformis*, Crouan, l. c. p. 196.

On cow-dung. C. E. Broome.

PLATE XVII. fig. 31. *a.* Ascus with paraphyses, magnified; *b.* sporidia, '0004–'0005 inch long, '0003 wide, more highly magnified.

1087. *A. microsporus*, n. s. Cupulis minutis, albidis, depressis; ascis elongatis; sporidiis ellipticis, demum violaceis, lævibus; paraphysibus apice globosis, endochromate viridi-luteo repletis.

On dung of cows and sheep. Bathford, Batheaston, C. E. Broome.

Cups very minute, paler than in the last, dirty white or yellowish brown, hymenium granulated with the tips of the asci, which are often furnished at the base with a little narrow oblique stem; sporidia '0003 inch long by '00015 wide, quite smooth; tips of paraphyses filled with coloured endochrome, which makes them very conspicuous. This differs materially from *A. granuliformis* in the size of the fruit, which is proportionally narrower; the colour also is different.

PLATE XVI. fig. 28. Asci with paraphyses, magnified.

1088. *A. argenteus*, Curr. MS.

On cowdung. Eltham, Nov. 1863, C. E. Broome.

PLATE XVII. fig. 32. *a.* Asci, magnified; *b.* sporidia, '0005 inch long, '0003 wide, more highly magnified.

1089. *A. macrosporus*, Crouan, Ann. d. Sc. Nat. sér. 4. vol. vii. p. 74.

On sheep- and horse-dung. Batheaston, C. E. Broome.

Mr. Currey observes that the amethyst-coloured episporous tears off in riband-like shreds.

PLATE XVII. fig. 33. *a.* Plant with projecting asci, magnified; *b.* ascus

with paraphysis, more highly magnified; *c.* mass of sporidia surrounded by gelatine, ditto; *d.* immature sporidium, ditto; *e.* mature sporidia, .0025 inch long; *f.* sporidium with shreds of epispore; *g.* epispore, more highly magnified.

1090. *A. Kerverni*, Cr. Ann. d. Sc. Nat. sér. 4. vol. x. p. 193.
On old cow-dung. Bathford, C. E. Broome.

PLATE XVII. fig. 34. *a.* Ascus with sporidia in a young state, magnified; *b.* ascus with paraphyses and sporidia when mature, more highly magnified; *c.* tip of ascus, ditto; *d.* paraphysis with mature sporidia, ditto, .001 inch long. The sporidia are dark violet when mature, and not reticulated. When young, they nearly fill the ascus; but, when mature, are confined to a small space. When their proper envelope bursts, a number of minute globular bodies escape, apparently of a different character from the coarser ones which fill the space between the primary and secondary membranes when they are immature, fig. *c.*

1091. *A. sexdecemsporus*, Crouan, *l. c.* p. 195.

On horse- and cow-dung. Hanham, near Bristol, C. E. Broome.

PLATE XVII. fig. 35. *a.* Ascus, magnified; *b.* paraphyses, ditto; *c.* sporidia, .0006 inch long, more highly magnified.

**A. saccharinus*, B. & Curr., Berk. Outl. p. 374.

On old leather and rag. Chislehurst, F. Currey.

PLATE XVII. fig. 36. *a.* Ascus, magnified; *b.* sporidia, .0008 inch long, more highly magnified.

1092. *Actidium Hysterioides*, Fr.

On chips, under fir trees. St. George's Hill, Weybridge, May 5, 1861, F. Currey.

1093. *Sphinctrina tigillaris*, n. s. Stipite brevi, cylindrico; capitulo elliptico; sporidiis oblongis, uniseptatis.

On an old *Polyporus* from a beam in King's Cliffe Church, and on wood at Batheaston, C. E. Broome.

Extremely minute, looking at first like a little *Stilbum*. It gives off a few threads on the surface of the matrix. The stem consists of little oblong cells. Sporidia .00015--0003 long.

1094. *Tuber excavatum*, Vitt.

Rudloe, Batheaston, Leigh Wood, &c., C. E. Broome.

**Genea hispidula*, Berk.

This was formerly referred to *Genea papillosa*, Vitt., of which Tulasne thought it might be a variety, though he adopted the name given above. Vittadini, however, on seeing specimens, pronounced it to be perfectly distinct.

1095. *Xylaria vaporaria*, Berk. MS.; Curr. *l. c.* figs. 17, 26.

This curious plant was sent from Cornwall, in the shape of a *Sclerotium* which abounded in a mushroom-bed, to the destruction of the mushrooms. One of the specimens, under the care of Mr. Currey, developed the very curious species of which he has given a figure.

1096. *Valsa lageniformis*, Curr. l. c. f. 16. *Sphæria lageniformis*, Sollman, Bot. Zeit. 1862, p. 380.

On ash. Combe Place, Lewes, Sept. 1862, F. Currey.

**Sphæria* (Villosæ) *pilosa*, P.

We have observed oblong conidia, rather irregular in outline, terminating the hairs. The asci in the same specimens, besides the eight linear, oblong, somewhat sigmoid sporidia, had at the tip a globose, smooth or slightly granulated body, .0003 inch in diameter, the nature of which we were unable to determine.

1097. *S.* (Denudatæ) *fmicola*, Roberge, Desm. no. 2061.

On asses' dung, Rhyl. It is apparently a common species.

Sporidia elliptic, brown, with a large oil-globule, green when young, .0006–0008 long, .0004 broad.

This is, we believe, *S. stercoraria*, Curr., var., Tr. Linn. Soc. 1859, no. 256.

Delicate, nearly linear stylospores occur at the mouth of the perithecia, .0007 inch long.

1098. *S.* (Obtectæ) *Fraxinicola*, Curr. l. c. xxiv. p. 158, fig. 34.

On dead branches of ash. Combe Place, Lewes, F. Currey.

1099. *S.* (Obtectæ) *verecunda*, Curr. l. c. p. 158, tab. 25. fig. 3.

On sticks. Batheaston.

1100. *S.* (Caulicolæ) *Triglochinicola*, Curr. l. c. f. 15.

On carpels and stems of *Triglochin palustre*. Ringmer, Sussex, Oct. 1862.

1101. *Nectria hirta*, Blox. MS.; Curr. l. c. p. 158, tab. 25. fig. 24.

On decaying rails. Twycross, Rev. A. Bloxam.

**Hypomyces luteo-virens*. Ashton Court, near Bristol, Jan. 1845. Bathford, upon *Polyporus annosus*, Nov. 1864.

H. luteo-virens, b, figured by Albertini and Schweinitz, is certainly different, and may be called *H. viridis*, retaining the original specific name. The dull green colour is characteristic. The whole habit too is different.

1102. *Hypomyces aurantia*, Tul.

As there was some doubt about *Sphæria aurantia*, Eng. Fl., being the true plant of Persoon, it was omitted in the 'Outlines.' It has now, however, been found in abundance in Flintshire, on *Polyporus squamosus*, and it is inserted under the generic name proposed by Tulasne for some allied species.

There is a very pale honey-coloured variety, springing from a snow-white subiculum, which accompanies the darker form. In both, the sporidia sometimes assume the peculiar swollen form which is figured by Tulasne in *H. lateritia*, at tab. 3. of the second part of his 'Carpologia.'

1103. *Perisporium vulgare*, Corda, fasc. 2. fig. 97.

On old rope. Batheaston, Nov. 1864.

Sporidia in chains of four, .00025 inch long when separated; asci with a delicate stem.

[To be continued.]

XLVIII.—*A Contribution to the Ichthyology of West Africa.*

By Dr. ALBERT GÜNTHER.

THE British Museum has lately received a small collection of West-African fishes, a part of which deserve some attention, inasmuch as they appear to be undescribed, or at least new to that fauna. We do not know the exact locality where these specimens have been obtained, but it is probable that they are from the Niger. The collection contained, besides other well-known West-African species, large examples of *Lates** *niloticus*, *Clarotes laticeps*, and *Citharinus latus*, which had been known hitherto from the Nile only; also *Distichodus rostratus* and *Alestes macrolepidotus*, and, finally, the common Indian *Drepane punctata*.

The following are new :—

Synodontis guttatus†.

D. 1/7. A. 12. P. 1/10. V. 8.

The gill-opening extends downwards to before the root of the pectoral fin. Mandibular teeth shorter than the eye, about thirty in number. Maxillary barbels about as long as the head, not fringed; mandibular barbels provided with filaments, the outer ones much shorter than the head. The length of the head is rather less than two-sevenths of the total length (without caudal). Nuchal carapace not much arched, longer than broad; its posterior processes extend somewhat behind the dorsal spines. Dorsal spine a little longer than that of the pectoral fin, but shorter than the head; both these spines smooth in front. Humeral process nearly twice as long as high, pointed behind. The distance between the dorsal and adipose fins equals the length of the latter, which is nearly as long as the head. Body

* The genus *Lates* has been described as being without pseudobranchiæ. However, it may be seen in large specimens that these organs are present, although the fringes are extremely short and may be easily overlooked; they are well developed in *Lates colonorum*.

† I take this opportunity of directing attention to the misplacement of the heading "B. Mandibular teeth not longer than the eye," in p. 212 of the 5th vol. of the Catalogue of Fishes. It should stand before "3. *Synodontis serratus*," instead of before "4. *Synodontis schal*," as indeed is evident from the remarks made on these two species in p. 210.

with numerous brown spots, which are small and rounded on the hinder part of the tail and on the adipose fin.

The single specimen is stuffed, and 29 inches long.

Synodontis labeo.

D. 1/7. A. 12. P. 1/9. V. 7.

This species is very similar to *S. xiphias*; but the snout terminates in a large, soft, globular swelling, instead of a conical pointed process. Humeral process twice as long as broad, with an obtuse point behind, slightly turned upwards. Angle of the mouth with a black cutaneous flap or prominence (shrivelled up in our specimen).

In all other characters this remarkable species agrees with *S. xiphias*, as far as we can see from the single stuffed example in the collection; it is 33 inches long.

XLIX.—On the Sexes of the Alcyonaria.

By M. LACAZE-DUTHIERS*.

NATURALISTS have paid less attention to the reproduction of the Coralliaria than to their external characters. At this we may justly feel surprised, when we consider that in other divisions of zoophytes the study of the phenomena which govern the preservation of the species has led to the most important discoveries.

In the different memoirs that I have presented to the Academy I have endeavoured to make known the sexual conditions which are met with in widely separated types, such as *Corallum*, *Antipathes*, *Gerardia*, &c. In the present paper, leaving on one side the isolated species, I propose to give a summary of the more general facts relating to the very natural division of the *Alcyonaria*; and for this purpose I shall take my examples partly from the species in which the zoanthodema is fixed, and partly from the *Pennatulidæ*, of which the polyparies always remain free.

In *Corallum* the genital glands are sometimes separated, sometimes united, either in the same polype or in the same zoanthodema; but, although hermaphroditism sometimes occurs, it must be confessed that the separation of the sexes appears to be the most usual condition; it appears even to become the general rule in the entire group of the *Alcyonaria*, if we may judge from the following genera and species—*Gorgonia subtilis*, *G. tuberculata*, *Muricea placomus*, *M. violacea*, *Primnoa verticil-*

* Translated by W. S. Dallas, F.L.S., from the 'Comptes Rendus' for April 24, 1865.

laris, *Bebryce mollis*, *Alcyonium palmatum*, *A. digitatum*, and *Paralcyonium elegans*—in which there is no doubt that not only the polypes, but even the zoanthodemata are unisexual.

The observations which form the subject of the present memoir, having been greatly multiplied throughout two consecutive springs and summers, appear to have furnished certain results; nevertheless it must not be forgotten that it is very difficult to assert absolutely that a large specimen, often containing several thousand polypes, has not a single animal of a different sex from that which appears to exist in it exclusively; I must therefore make every reservation with regard to any exceptions that may present themselves.

In order to ascertain the nature of the genital glands, we must always commence by a microscopic examination and histological investigation of the characteristic elements—that is to say, by recognizing the *spermatozoid* and the *ovum*. This is the only means of obtaining certain results, which may afterwards allow us to judge rapidly of the sexes, on the condition, however, that the productive organs of these elements, or these elements themselves, present such differences as may be appreciable by the naked eye.

When the ovum and the testes present at the same time the same form and the same colour, it is impossible to distinguish them without the microscope; and in this case it will be understood how laborious the observations become. But fortunately this is very rarely the case, for almost always these elements present some prominent differences.

In *Gorgonia subtilis*, for example, the ova are of a splendid carmine rose-colour, whilst the male organs are colourless: the former are large, and rarely exceed two or three in number; the latter, on the contrary, are small, and form eight racemose packets, each composed of ten capsules. This fact once ascertained by the microscope, it is easy, by means of large incisions, or even by simply tearing the sarcosoma with the nail, to distinguish the male and female zoanthodemata very rapidly. I have very often done this without ever being deceived, although the fishermen brought me specimens by hundreds. The observation of *Gorgonia subtilis* is so easy, and furnishes such precise results, that it may serve as a type of researches of this kind.

In the *Muriceæ* the ova have a bright colour, resembling that of the sarcosoma; the testicular capsules, on the contrary, are very pale or nearly colourless. One of the species, *M. placomus*, which abounds on the coralligenous banks of the Mediterranean, is of a fine slightly yellow orange-colour, but without brilliancy; its ova are of the same tint, but their shade is redder, brighter, and more brilliant; its testes are sometimes nearly white, but

most frequently of a pale orange. The other species, *M. violacea*, has its tissues of the most beautiful violet that can be imagined; its ova are of a softer shade, in which blue predominates; its testes are scarcely tinged with a slight tint in which blue predominates still more. But in these two species, whilst the secretion of the ovaries is always reduced to about ten ova, the testis produces eight packets formed of from six to twelve capsules. It is therefore easy with the lens, or even with the naked eye, to ascertain the sex of these species; and it is only quite exceptionally that I have found upon the same zoanthodema the two kinds of genital glands.

We should only have to repeat the same things with regard to *Primnoa verticillaris*, *Alcyonium digitatum*, and *A. palmatum*. In the two latter species, when we give a broad scalpel-cut into the lobate fleshy mass of which their zoanthodemata consist, we see, if the animals are breeding, thousands of ova or of testicular capsules separating from the long pedicels which bear them, as in all *Alcyonaria*, and escaping from the cavities of the polypes.

Bebryce mollis might sometimes seem to form an exception: but it is to be remarked that its zoanthodemata, when they meet, become soldered together and confounded; so that sometimes it must appear that there is only a single colony of both sexes, when in reality the sexes have been originally distinct, and the appearance of bisexuality is the result of a graft by approach.

Alcyonium palmatum lives well and for a long time in aquaria; so that it is easily observed. When it is well expanded and much inflated, it shows, shining through its attenuated walls, the numerous globules of the interior of its cavities, which may easily be recognized as ova or testes from the difference in their form and size.

In *Juncella elongata* the parenchyma is of a fine sienna-colour; the ova are large, not numerous, and white: it is therefore easy to ascertain the sex in this species without the aid of magnifying-instruments, after having positively determined histologically the nature of the glands.

Thus in the species of *Alcyonaria* with a fixed base, living in the Mediterranean, the sexes appear to be always separate; for the polypes, like the zoanthodemata, only present one kind of genital glands.

In the *Pennatulidæ* or free *Alcyonaria* the same thing is presented. In *Pennatula grisea*, *P. rubra*, and *P. granulosa* I have never found the sexes united; but I must add that I have examined a far smaller number of individuals than in the case of the other *Alcyonaria*.

It is hardly possible to investigate the phenomena of reproduction in the lower divisions of the animal kingdom without

directing one's attention to the peculiar conditions often presented in the lower animals by the multiplication and metamorphosis of individuals. Although I have sought carefully in the group to which I have just been referring for alternations between a sexual and an agamic generation, I have never met with it. The number of zoanthodemata is only increased sexually. Blastogenesis or gemmation extends the zoanthodemata or colonies by multiplying the number of inhabitants in each of them; but these budded individuals are soon sexual, resemble those from which they are derived, and assist in reproduction by fecundation, without presenting any peculiarity except their origin.

It is constantly the case in the whole of this group that fecundation takes place in the general cavity of the body of the female, or even in the ovary, and that the female hatches her ova after impregnation; thus she does not produce eggs, but, by a true parturition, rejects by the mouth ciliated vermiform embryos or larvæ, which attach themselves after having for a short time enjoyed complete freedom.

L.—*Observations on Raphides and other Crystals in Plants*.

By GEORGE GULLIVER, F.R.S.

[Continued from p. 382.]

Dictyogenæ.—At the end of the last communication, the deficiency of raphides in the Cryptogameæ Ductulosæ was noticed, as well as in Potamogetonaceæ, Naiadaceæ, Cyperaceæ, and Gramineæ, which four orders conclude the class Monocotyledones in the 'Manual of British Botany;' and I had before shown how raphides constantly abound in the subdivision Dictyogenæ, therein placed at the beginning of this class.

Now the orders Coniferæ and Hydrocharidaceæ, between which is the position of Dictyogenæ in the lineal series of the natural arrangement of that book, are as regularly devoid of raphides. Extending the inquiry from the flora of Britain to that of the world, the facts, as far as my observations have yet gone, are to the same effect. Thus the fifth class in Prof. Lindley's 'Vegetable Kingdom' is formed by the Dictyogens, and placed lineally between his Alismal Alliance and Gymnogens. But in no order of these last two groups have I yet found raphides, though I have searched some of the exotic as well as all but one of the indigenous species; while every plant belonging to the Dictyogens, either native or foreign, that has ever come under my examination was constantly found abounding in raphides.

Hence, besides the diagnostics already described by systematic

botanists, it must now be admitted that the British Dictyogens also truly and naturally differ, in the possession of this character of raphis-bearing, from their nearest neighbours of other orders. And the same character has been found in every exotic species of the class hitherto examined by me in this respect.

The names of the plants thus examined have been specified in preceding parts of these Observations. And since the present paper was in type, Mr. W. H. Baxter, the botanist to whom I have so often been indebted for generous assistance in these inquiries, has sent me fragments of leaves of three Dictyogens, of which notes of my examinations here follow:—*Dioscorea discolor*: raphides swarming. *Philesia buxifolia*: raphides much less abundant, but yet rather numerous. *Roxburghia gloriosoides*: true raphides very scanty; but a profusion of crystal prisms lying singly between and parallel with the transverse veins of the leaf.

Araceæ.—In the last communication, it should have been noticed that I have found, as was expected, an abundance of raphides in *Pistia stratiotes*; they occur with a plentiful crop of sphæraphides in this plant, and the cells of both are very distinct.

Nyctaginaceæ.—Besides the plants mentioned in the ‘Annals’ for last October, I have recently, through the courtesy of Mr. W. H. Baxter, had an opportunity of examining fragments of several dried specimens of this order. Of these the following are notes:—*Boerhaavia paniculata* [leaves, twig, and flower-buds]: abounding in raphides. *Collignonia scandens* [leaf and flower]: raphides small and very scanty, with some bits of larger crystal prisms. *Neea obovata* [leaf and flower]: many raphides and larger crystal prisms. *Pisonia aculeata* [leaf, flower, and twig]: raphides abundant in the flower and twig, and, with many crystal prisms besides, in the leaf. *Tricycla spinosa* [stalk, leaf, bracts, and fruit]: raphides swarming in all these parts, and some in the corolla and seed-skin. *Okenia hypogæa* [twig and leaf]: raphides abundant. Add to these, cultivated plants of *Abronia*, in the leaves and seed-leaves of which, as well as in the persistent calyx of the fruit, I have constantly found numerous raphides.

Taking the orders Plantaginaceæ, Nyctaginaceæ, and Amaranthaceæ as they stand lineally in Prof. Balfour’s ‘Manual of Botany,’ the central and exotic order differs (like three orders of our native Dicotyledones; ‘Annals,’ July 1864), in the possession of this character of raphis-bearing, from its next neighbouring orders. And so, too, regarding the recognized affinity of Nyctaginaceæ with Chenopodiaceæ, the result is still similar; for, although I have often shown how abundant sphæraphides are in this last order, I have not seen true raphides in it; nor have I
 u nd Polygonaceæ a raphis-bearing order.

In short, while every plant that I have examined of the order Nyctaginaceæ constantly afforded raphides, all the plants examined of its neighbouring orders just mentioned were as regularly found to be devoid of raphides.

It is also noteworthy how we now see the trees and shrubs of this exotic order (Nyctaginaceæ) abounding in raphides—a fact of which no parallel has yet appeared to me in our native flora; indeed I do not recollect a single example of true raphides in any British tree or shrub, excepting *Ruscus*, a small shrubby liliaceous plant ('Annals,' July 1864).

Ficoidales.—In this alliance Prof. Lindley includes the orders Basellaceæ, Mesembryaceæ, Tetragoniaceæ, and Scleranthaceæ. True raphides swarmed in every species examined by me of *Mesembryanthemum* ('Annals,' Oct. 1864); and a late repetition of many of those observations, with additional examinations of at least eleven species (being all I could collect), have afforded the same result. But I have never yet found raphides in any other plant belonging to the Ficoidal Alliance, after having searched for them in more than one species of each of the other three orders. And when we took the orders Crassulaceæ, Ficoideæ, and Cactaceæ as they occur successively in Prof. Balfour's 'Manual,' the result was similar—*Mesembryanthemum* still isolated, as a great raphis-bearing group, from those neighbouring orders ('Annals,' May 1864). Of Basellaceæ and Tetragoniaceæ, besides the plants specified in former communications, I have lately searched in vain for raphides in dried fragments of three species of *Trianthema*, one of *Anredera*, and in the fresh leaves and root-stock of *Basella tuberosa*—all plants affording sphæraphides, like those of Chenopodiaceæ. Finally, again by the kind aid of Mr. W. H. Baxter I have examined dried portions of *Glinus Mollugo*, *G. lotoides*, and *Lewisia rediviva*, in neither of which could any raphides be found.

Here, then, as far as these observations have yet extended, is this vast genus *Mesembryanthemum* distinguished as a raphis-bearing group from all its allies—a difference so remarkable and natural as to make it very desirable that every one of these plants should be examined in this respect by those botanists who may have the means of extending and correcting the present results. And it should be recollected that the sphæraphides which I have found so abundantly in Tetragoniaceæ are not to be confounded with raphides, but are so like the sphæraphides of Chenopodiaceæ as to make a curious resemblance in this respect between these two orders, in addition to the affinity already noticed between them by Prof. Lindley.

Edenbridge, May 15, 1865.

[To be continued.]

LI.—On the History and Habits of the *Epeira Aurelia* Spider.

By FREDERICK POLLOCK, Esq.

I AM not aware that the history of a spider has ever been written ; and I am therefore induced to give the result of my observations in Madeira, in 1864–65, upon the *Epeira Aurelia*, which I watched very closely, day by day, for some months.

The favourite haunt of this spider is the prickly pear—a plant from which its cocoon can scarcely be distinguished in colour, and so close is the resemblance that, the first time I saw one of these cocoons, I could hardly believe that it was not a withered piece of the cactus to which it was attached.

This cocoon (which is always made in one night) is composed of an inner, soft, globular covering for the eggs, surrounded by a tough, parchment-like case, about the size and shape of half a small walnut, of a faded light-green colour, and is suspended by a number of threads, stretching out in all directions to the surrounding plants. It is water-tight, and inaccessible to ants, which are almost the only enemies to spiders in the island ; and it contains from about 600 to 1000 bright yellow eggs, glued together in the shape of a bean.

By cutting several cocoons open, I ascertained that the eggshells burst at the end of the fourth week. The young spiders are then very helpless, and nearly transparent. At the end of the fifth week they cast off their first skin, and become quite lively and active.

They are at this time about as large as an ordinary pin's head, of a bright yellow, with darkish legs ; and three or four dark spots gradually develope themselves down each side of the abdomen. At about the end of the seventh week they emerge through a small hole (probably gnawed by them) from their prison, never to return to it.

They then club harmoniously together, hanging closely packed in a ball, upheld by an infinity of lines which they attach to the adjacent objects.

For the first ten days or fortnight of their freedom they thus live in amity, occasionally spreading out (probably for ventilation), but always, during that time, reverting to the form of a compact cluster, and eating nothing.

When the fortnight is over, their friendship ceases ; sometimes all of them, and invariably most of them, wander away, a very few remaining behind near their birthplace.

Hitherto they have merely made lines ; now each individual makes a web for itself, about as large as a penny piece, to catch its neighbour, or any other prey which may come within its clutches.

From the extreme tenuity and want of strength of these webs, there are very few insects feeble enough to be held by them ; and the consequence is, that hundreds of the spiders, at this precarious period of their existence, perish from starvation or other causes, and I have been led to the conclusion that not more than one or two (if so many) out of each cocoon survive, though, having once passed this period, very few of them appear to die until the natural time arrives.

It is next to impossible to watch them closely, or speak with any degree of certainty about them, at this early stage of their life, not only on account of their being so small, but because they are then exceedingly migratory. If there be a gentle breeze and they feel so disposed, they float away on the light gossamer threads they can let out to almost any distance they please, without one's being able to prevent it.

In the hope that I could the better observe them, I had a large glass case made to keep them in ; but I found that they did not thrive well in captivity, especially at this period of their life ; for, amongst thousands confined for four or five months, not one appeared to grow larger, or change in any respect, except perhaps to become a little darker.

In the glass case the young ones never made webs, but merely lines ; and, without a regularly constructed web, spiders scarcely have the power, or apparently the inclination, to catch prey : so they gradually died off.

"It is all fish, however, that comes to the spider's net." They make no distinction between a brother and a blue-bottle fly ; and though the young did not live upon each other in confinement, they were food (and the only convenient food I could get) for some others of a size larger in the glass case, which did make webs.

A fortnight after the young spider leaves the cocoon, it begins to construct snares, to feed, to grow, and to become darker.

I cannot say positively, but I believe, in a month or two from that time, according to the food it gets, it changes its skin.

The females have nine changes after leaving the cocoon. From the first to the eighth these changes take place pretty regularly, under favourable circumstances,—in times increasing gradually from about fifteen to twenty-five days, though one spider in the glass case (having had one or two changes) remained for forty-five days without changing, and then died.

For about two days preceding each change the spider seems to eat nothing, and to remain motionless.

The operation of getting out of the old skin is a strange-looking performance, and is thus effected :—The spider is fastened firmly, by a thread from the spinnerets, close to the underside

of the web: the legs are all gathered together, and likewise appear to be fixed to a spot close by: the body hangs downwards, the skin begins to split at the sides, and the spider, by a succession of powerful efforts, lasting about half an hour, gradually draws its legs out of the old skin.

When fairly freed, its former attitude is reversed; for it hangs with the end of its abdomen uppermost, and its legs dangling loosely down (a position it never assumes at any other time); and so little does it look like its ordinary self, or anything else that I know of, under these circumstances, that one is puzzled on first seeing it in this posture to imagine what it can be.

The legs are now quite soft, flexible, and semitransparent, the abdomen slender, and the spider very feeble and exhausted.

It can scarcely crawl, or exert itself in any way. It remains stationary for about an hour, then turns its legs up, and climbs by its attaching-line to the web, where it remains motionless for for some forty-eight hours, after which it resumes its usual habits.

Should it at any time whilst young lose a limb or part of one, nothing appears to occur towards its reproduction, until at least one subsequent change of skin has taken place; some time after which, the leg or part of it grows again, but is not much more than half the length of the corresponding perfect part, and is of a somewhat lighter colour.

These stunted limbs are of little use to the spider; and, as far as I could make out, there is no reproduction at all of limbs lost after the seventh change of skin.

I have said that the changes take place regularly from the first (after leaving the cocoon) till the eighth. Then the spider is adult, and begins making cocoons—the first in a month's time, and others at periods within from about fifteen to twenty-five days apart.

About a week after the fifth cocoon has been made, the spider changes its skin for the last time, rests from its egg-laying for about thirty days, makes five more cocoons at intervals of from fifteen to twenty-five days, and dies a week or so after making its last one.

The spots which the young spiders have on the sides of the abdomen gradually disappear, and give place to very handsome markings of regular and even transverse bands of silver and orange across the abdomen, alternating with black, a silvery thorax, and transverse stripes of brown and black on the legs; but as this spider's appearance has been described by Walckenaer, it is unnecessary for me to say more about it, except that the largest females have a body $1\frac{3}{8}$ ths of an inch long, and a fore leg $2\frac{3}{8}$ ths, which is very much larger than our largest British garden-spider.

Hitherto we have been treating only of the females. There is a very great difference between their size and that of the males, the latter, when full-grown, being only $\frac{3}{16}$ ths of an inch long, with a fore leg $\frac{1}{2}$ an inch. Moreover the male has only four changes of skin, which appear to take place at much the same periods as the corresponding changes of the female. Indeed the habits and history of both sexes are precisely similar until the fourth change, but no longer. The male then entirely ceases making webs, eats nothing, and, from having been very sedentary, becomes a rover, wandering about from web to web of the females. His abdomen, from want of food, shrinks; and his thorax, partly from contrast, and partly owing to his large palpi, bears a different proportion to that of the females, and makes him rather unlike them.

This spider makes a flat, circular web, which it hangs in a nearly vertical position. The webs of the youngest have the same beautiful symmetry as those of the oldest spiders. They consist of strong, tightly stretched, and inadhesive radial lines, crossed by a much thinner and looser spiral line, or concentric circles, which are very sticky.

In a full-sized web there are about 250 feet of thread, made up of about 35 radial lines and 38 concentric circles, the outer of which is some 20 inches in diameter.

The web is almost invariably constructed at or near early dawn, seldom or never during the day, the old one being destroyed before a new one is begun.

The radial lines are first made; then the outer circle, from which the spider, walking round and round the web, and working towards the middle, lays down the spiral line, joining it to the radial lines wherever they cross each other.

At a distance of about two or three inches from the centre this gummy line ceases, and there is an interval sufficiently large to allow the spider to creep through to the other surface of the web; the spiral line is then resumed, rather irregularly, to the centre, but it is no longer adhesive, so that the spider has always a dry and comfortable resting-place.

Sometimes (though not always) it works upon the web, and from its centre, a broad, white, zigzag line of thread, in a vertical direction; and I am inclined to think from this, that a certain quantity of the web-producing fluid is daily secreted, and, if there be any surplus, it is got rid of in this elegant manner, which the natives of Madeira call "writing the spider's name" on the web.

After the lapse of a day or two, the adhesive property of the web disappears, and it no longer catches flies: a fresh one must consequently be made, sometimes daily, sometimes after two

days, according to circumstances ; but, unlike the house-spider's, this web is never repaired.

When finished, the spider suspends itself by a double attachment from the centre of the under side ; that is to say, it attaches its abdomen by a line, and it holds on with its legs ; and so, if it should get alarmed, it can at once let go its hold with its legs, and, after dropping a foot or two, stop, without falling far enough to get injured by striking the ground underneath ; and this power that it has of suddenly stopping in its fall shows, I think, that the fluid from which the thread is made has the singular property of drying instantaneously.

In the middle of their webs, the spiders constantly hang, with their head downwards, waiting patient and motionless until accident shall have brought some kind of prey into their snare.

Their sensitiveness to the struggles of a captured insect is quite astonishing ; for, without seeing or going near to it, the spiders are at once aware if the insect is unsuited to them, and, should such be the case, they either let it alone or by violent jerks shake it off. Again, when a gale of wind is blowing, and one would imagine that all other motion would be absorbed in the tremendous agitation of the web, the spider immediately knows when a fly is caught, and hurries down to seize it, at the risk of being blown away itself.

Should a wasp, bee, or other formidable creature be captured, they approach cautiously, keeping it at arm's length ; then spreading out their spinnerets to get a broader thread, wind the insect round and round, till it is encased like a mummy, and can no longer offer resistance, and then triumphantly carry it off to the centre of the web, where they always devour their food.

The most formidable thing I ever saw one of them conquer was a very large humble bee, so much heavier than the spider that the web could only just sustain its weight. The *Epeira* did not hesitate, however, but at once walked down to it, rolled it up, and in a very short time put an end to its struggles and its life.

It is remarkable that the spider is never attracted to anything which does not move, and consequently never eats what it has not itself killed. If two insects happen to be caught at the same time, one is first rolled up, then a line attached from it to the centre of the web, and then the other is treated in precisely the same way ; but no insect is ever rolled up without having a line made from it to the centre of the web, and this line unerringly and at once leads the spider to the prey it may have captured hours ago. As far as my observations go, I believe that spiders generally are guided much more by the sense of feeling than of

sight. I have seen a large insect almost touching a spider in its web, but terrified and motionless; and as long as it remained thus, the spider did not take the least notice of it, not knowing apparently that it was there; directly, however, it began to move, it was attacked and rolled up.

I have said that the young spiders are very migratory. After a change or two of skin they are equally stationary, and will, I believe, if they find a suitable place, never move more than a foot or two from it during their life, making web after web, and cocoon after cocoon, in almost identically the same spot.

They appear to be quite harmless to man, as I have frequently handled the largest with perfect impunity.

Their voracity, which is very great, is only equalled by their powers of endurance; for they will live for a week or ten days without food, and apparently without being much the worse for it. One male spider, which I had in a glass case, remained for forty-eight days, after its final change, without eating; and when I let him go, he was quite brisk and lively. I may also mention that when it was necessary that an adult spider should be weighed (in order to find the rate at which they grow), thinking that the quickest and easiest manner of ending its life would be to put it into hot water, a jug was brought, the spider dropped in, and it apparently died at once; so, taking it out of the hot water, I dried it thoroughly, and put it into the scales. To my utter surprise, it began, after a while, to show signs of returning life. When sufficiently recovered, I placed it carefully back into its web, and from that time forth it was just as healthy a spider as any untouched one, perhaps all the better for its cleaning and its bath.

I found that at the end of eight months it is 2700 times as heavy as at its birth!

The nutriment it takes during the first half of its life is devoted entirely to increasing its size; that of the last half almost as entirely to the production of eggs.

We have seen that it has altogether ten changes of skin—one in the cocoon, and nine out of it; and that it makes ten cocoons, and lays about 8000 eggs.

So regular are the habits of this spider, that it may be likened to a machine which is made for performing a given amount of work and no more. If it can procure an abundance of food, it will live for about eighteen months; and it may appear somewhat anomalous, but nevertheless I believe it to be a fact, that by lengthening out the time in which it gets its food you may considerably prolong its existence, though you cannot get more work out of it, either in the shape of growth, or changes of skin, or laying eggs.

The history of one *Epeïra Aurelia* is the history of the whole species.

It works with the most consummate skill; but when it has made its marvellous snare for the capture of prey, it trusts to accident alone, and uses no artifice to entice that prey. So also with regard to its cocoon. Nothing could be more perfectly adapted to the purpose for which it is intended; but directly this beautiful structure is finished, the spider is utterly indifferent to, and apparently ignorant of, its existence, which is proved by my having always taken away the cocoons the morning after they were made, without producing the slightest effect upon the *Epeïra*.

Thus they are governed in everything they do by an all-wise and immutable law, which compels them, so to speak, to make the best provision for themselves and for the protection of their eggs—for the permanence and reproduction, in short, of their race; and this, it would seem, is the end and aim of their existence.

Thurlow, Clapham, S., May 1865.

LII.—Notes on the Hydroida. By Prof. ALLMAN, F.R.S.

I. *Syncoryne pulchella*, mihi, n. sp.

IN April last I obtained at Skelmorlie, on the Firth of Clyde, a pretty little Corynidan Hydroid, which might have been seen spreading in small patches over the bottom of the rock-pools near low-water mark. It turns out to be a species of *Syncoryne**, distinct from any hitherto described, and may be defined by the following diagnosis.

Trophosome.—Hydrocaulus consisting of simple stems rising at intervals from a creeping reticulated stolon, and attaining a height of about half an inch; periderm destitute of annulation, and only with a few shallow transverse corrugations towards the base. Polypite with fifteen to twenty tentacles. Body of polypite deep orange, becoming pale where it passes into the stem; stem orange.

Gonosome.—Gonophores borne on short peduncles in a dense cluster immediately behind the most posterior tentacles. Um-

* The name of *Syncoryne*, adopted from Ehrenberg in a restricted sense, is intended to embrace those species of the older genus *Coryne* which have phanerocodonic gonophores, referable, at the period of their liberation, to the type of *Oceania* as limited by Forbes and, still more definitely, by Gegenbaur. (See a paper on the genera of the Hydroida in the 'Annals of Nat. Hist.' for May 1864.)

brella of Medusa set with scattered thread-cells, and with its transverse and vertical diameters nearly equal. Two longitudinal furrows exist upon the concave surface of the umbrella; they are situated exactly opposite to one another, each occupying the middle line of the interval between two neighbouring radiating canals, and extending from the base of the manubrium to the margin of the bell. Marginal tentacles of Medusa very extensile, nodulated with clusters of thread-cells, which give them a moniliform character when extended, one larger spherical cluster terminating the tentacle. Tentacular bulbs with a distinct ocellus. Manubrium and tentacular bulbs deep orange.

Rooted to the bottom of rock-pools, near low-water mark, Skelmorlie, Firth of Clyde.

Syncoryne pulchella, though of humble habit, is yet conspicuous by the bright orange-colour of its polypites and medusa-buds. It is evidently nearly allied to the *Syncoryne decipiens** of Dujardin, with which indeed I was at first disposed to regard it as identical. It agrees with it closely in the form of the Medusa, and in the fact that all the gonophores are borne behind the most posterior tentacula. Like the Medusa of the present species, that of *S. decipiens* is described as being provided with linear longitudinal furrows on the concave surface of the umbrella. In *S. decipiens*, however, each of the four intervals which separate the radiating canals is stated to be occupied by one of these furrows, while in the present species only two of them are so occupied. The trophosome also of *S. pulchella* differs from that of Dujardin's species in its simple habit, in the more ovate form of the polypite, and in its more numerous tentacles.

With *Syncoryne eximia* the present species closely agrees in the form of the Medusa, though the trophosomes of the two species are very different from one another. The Medusæ, indeed, are scarcely distinguishable, except in the fact that the subumbrellar furrows do not exist in those of *S. eximia*.

The longitudinal furrows which we meet with on the concave surface of the umbrella are probably formed by a peculiar modification of the substance of the umbrella forming two fixed lines of attachment for the circular contractile fibres.

While examining the Medusæ which had been thrown off

* In a synopsis of the genera and species of the *Tubularinæ*, published in the 'Annals of Natural History' for May 1864, I regarded *Syncoryne decipiens*, Dujard., as a synonym of *S. Sarsii*, Lovén. Though in this view I followed so excellent a zoophytologist as Mr. Alder (Catal. Zooph. of Northumberland and Durham, Supplement, p. 3), I am now convinced that the two species are distinct.

from a group of *Syncoryne pulchella* in one of my jars, I was struck by observing two of these Medusæ united to one another by a small space on the convex surface of their umbrellas, at a short distance from the summit. One of the united Medusæ was a little smaller than the other; but otherwise they were both equally developed, and presented the ordinary condition of these zooids at the time of their liberation from the trophosome. The cavities of the two umbrellæ freely communicated with one another through the surface of junction.

That neither of the Medusæ thus so intimately united had been produced by a bud from the other was evident; for the original point of union with the trophosome and the canal by which the cavity of the manubrium had at one time communicated with the somatic cavity of the trophosome were still distinct in each; while these facts are also opposed to the view which would regard the twin Medusæ as representing a single one in the process of self-division.

The only explanation which it seems possible to suggest is that in the twin Medusæ we have a case of accidental adhesion contracted between two neighbouring buds while still connected with the trophosome, though it is difficult to see why this adhesion should have been followed by a free communication between the two umbrella-cavities. I never met with more than a single example; and, whatever explanation we may be disposed to offer as to its origin, it seems evident that it cannot be regarded as otherwise than an abnormal occurrence.

Though many of the Medusæ which, nearly a month ago, had become liberated from the trophosome are still living in my jars, no formation of generative elements has taken place in any of them. They have, however, all undergone a very remarkable change.

The commencement of this change might have been observed a few days after their liberation. The umbrella became everted, and then began to diminish in size, contracting from its margin towards its summit, until in a few days it had almost entirely disappeared, being then merely represented by a thick disk of a somewhat quadrangular form, which projected round the base of the manubrium. Each of the four angles of this disk was continued into one of the marginal tentacles, whose base, following the contraction of the umbrella, had been thus brought upon a level with the base of the manubrium. The interior of the disk was occupied by a cavity which communicated freely with that of the manubrium and with that of each of the four tentacles which extended from its angles. With the contraction of the umbrella the circular canal and velum had disappeared, and the radiating canals were now represented solely by the short

channels by which the interior of the hollow disk communicated, through the thickness of its walls, with the tubes of the tentacles. Neither tentacles nor manubrium had undergone any material change; the former retained their full power of extension and retraction, and the latter all its original irritability—moving from side to side, lengthening and shortening itself, opening and closing its mouth, with at least as much vigour as before the disappearance of the umbrella. The Medusa in this condition reminded us strongly of the gonophore of *Clavatella*, though the degradation of the umbrella was more complete than in the latter. The Medusa had in fact become changed by a retrograde metamorphosis into a polypite.

Changes had been noticed also by Dujardin in the Medusa of his *Syncoryne decipiens*; but he had not followed them beyond an eversion of the umbrella, which is probably the commencement of the changes resulting in the disappearance of this part of the structure.

Notwithstanding the very striking character of the changes now described, and their resemblance to a normal metamorphosis, I cannot see in them anything more than a degradation of structure resulting from imperfect nutrition—a mere forerunner of complete disintegration and death. They are, however, most instructive in their bearing upon the homologies between the Medusa and the polypite, and completely support the view that the radiating canals of the Medusæ are the homologues of the channels by which the gastric cavity of the polypite is continued through the thickness of its walls into the interior of the tentacles, which will then represent those marginal tentacles of the Medusa which constitute the continuations of its radiating canals.

II. The Production of an *Æginidan* by gemmation from Geryonia.

A discovery of great importance in its bearing on the true relations of the *Æginidæ* has been just announced by Ernst Haeckel*, who has seen a Medusa belonging to the family of the *Geryonidæ* (*Geryonia hastata*, Haeck.) giving origin, within the cavity of its manubrium, to buds which, instead of repeating the form of the *Geryonia*, become developed into a species of *Cunina* (*Cunina rhododactyla*, Haeck.), a Medusa belonging to the aberrant and hitherto perplexing group of the *Æginidæ*.

Further, according to the author's views, the bud-producing

* "Ueber eine neue Form des Generationswechsels bei den Medusen, und über die Verwandtschaft der Geryoniden und Æginiden." Auszug aus dem Monatsbericht der Königl. Akad. der Wissensch. zu Berlin, 2 Feb. 1865. [Translated in the present Number of this Journal.]

Geryonia is in a state of sexual maturity, and the buds which are produced by it become developed into sexual *Cuninæ*. And, still further, from having observed in the sea various free-swimming forms which he regards as different stages in the development of the *Geryonia*, he considers it probable that this Medusa is produced by a process of direct development from the ovum, his observations in this respect coinciding with those of Fritz Müller on the nearly allied *Liriope catharinensis**.

Of the phenomena thus observed he gives the following generalized statement:—A perfectly developed Medusa which has been produced by metamorphosis from a larva, and is capable of sexual multiplication, gives origin, by a process of budding in its stomach-cavity, to young Medusæ, which develop themselves into perfect sexual forms entirely different from that of the Medusa from which they spring. And in these facts the author believes that there is presented an entirely new type of alternation of generations—a type totally different in its fundamental principles from the phenomena which have been hitherto included under this name, and one for which a new term is needed.

While the observations of Haeckel, however, can scarcely be too highly estimated for the light they throw upon the relations between the *Geryonidæ* and *Æginidæ*, it appears to me that he greatly overrates the difference between the genetic phenomena which are here presented and those already well known among the Hydroida.

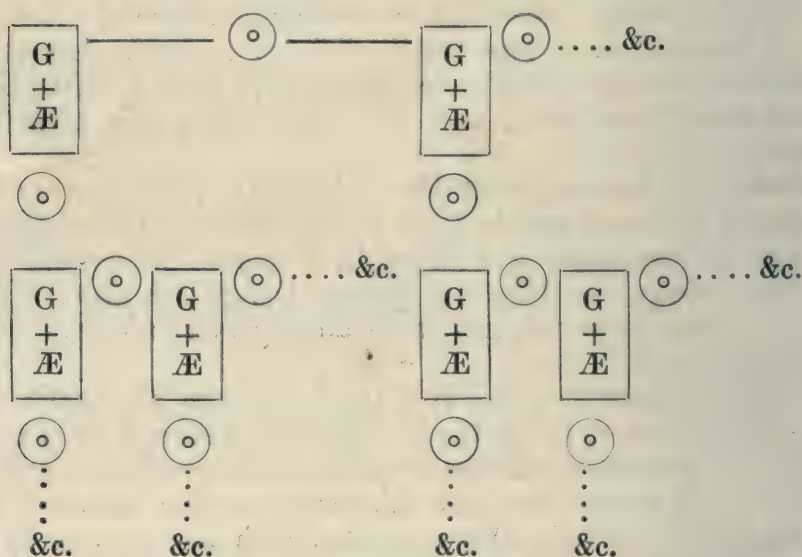
It must be kept in mind that the essence of alternation of generations consists (1) in the interposition, between every two acts of true generation, of one or more acts of non-sexual multiplication; (2) in the fact that the heteromorphic elements in an alternation are invariably connected with one another by a non-sexual and not by a sexual genesis; (3) in the fact that these elements exactly repeat themselves after each generative act.

Now in the present case, admitting that Haeckel has given a correct interpretation of the phenomena, we have the development of an ovum resulting by direct metamorphosis in a Geryonidan Medusa which produces by non-sexual reproduction an Æginidan Medusa, this last being sexually perfect, so that it gives origin to fertile ova. So far the phenomena would come exactly within the ordinary laws of alternation of generations; but a disturbing element is introduced by the fact of the *Geryonia* not only giving origin to buds, but also producing fertile ova. This is certainly an anomaly. I know of no other instance

* Wiegmann's Archiv, 1859, p. 310.

among the Hydroida in which all the zooids in an alternation of generations, whether capable of non-sexual reproduction or not, are at the same time sexual. But still the fundamental principle of the law is adhered to; the heteromorphic zooids in each period are connected with one another solely by gemmation, while the sum of the forms interposed between every sexual act is always exactly the same.

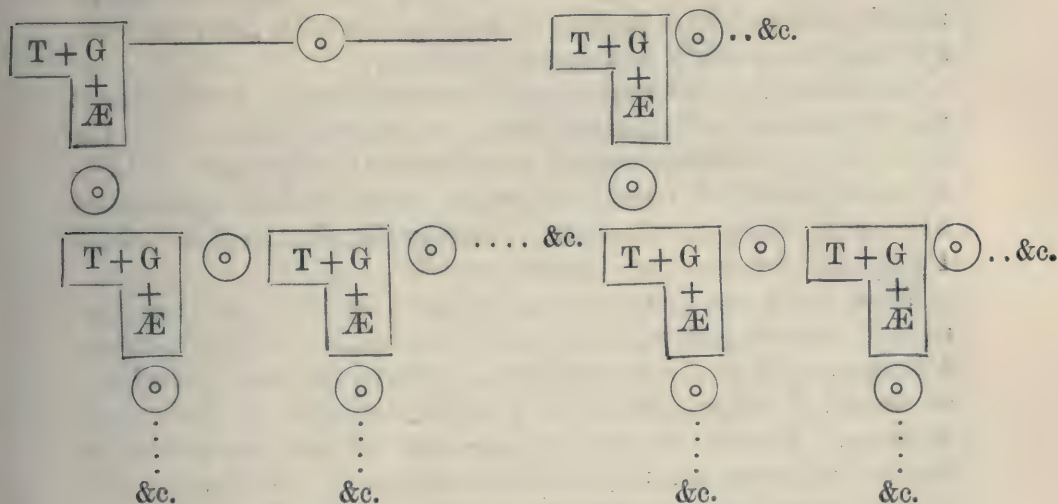
The phenomena in the present case may be expressed by the following diagram, in which the sign + is intended to indicate reproduction by gemmules, and \odot reproduction by ova; while G represents the Geryonidan and \mathcal{A} the \mathcal{A} eginidan element. The total result of the development of every ovum is included within a boundary-line; and it will be at once seen that it is in every case exactly similar.



It is here taken for granted that the development of the ovum in the Geryonidan element is the same as that in the \mathcal{A} eginidan element; and until reasons can be shown to the contrary, we are justified in making this assumption.

I have also assumed that Haeckel is right in supposing that the *Geryonia* is developed directly from the ovum, without the intervention of a polypoid trophosome; but it will be at once seen that there is no evidence of this, and that, though a true metamorphosis may be proved, the earliest stage of the Medusa may yet be that of a bud upon a fixed though as yet undiscovered trophosome. If this be regarded as the true view, the elements which compose each period in the above diagram must be preceded by another, namely the polypoid element, which will then be the *immediate* product of the development of the

ovum. With this change, the diagram of the alternation would stand as follows, where T represents the trophosome:—



Now many instances are known in which Medusæ originating as buds from a polypoid trophosome give rise by gemmation to other Medusæ, both sets of Medusæ being also in all probability capable of sexual reproduction. *Sarsia*, *Hybocodon*, *Clavatella* may be cited as examples of this phenomenon; and the diagram expressing it would exactly resemble that just given, with this difference, that while the medusoid elements are, so far as we yet know, similar in *Sarsia*, &c., they are heteromorphic in the other. Fritz Müller* has recorded a case in which an 8-tentacled *Cunina* gave origin to buds which became developed into another form of *Cunina* having its parts disposed in accordance with the number 12, instead of 8. This would therefore be a case of true heteromorphic budding. The bud-producing Medusæ, however, had not in this instance been traced to a polypoid trophosome.

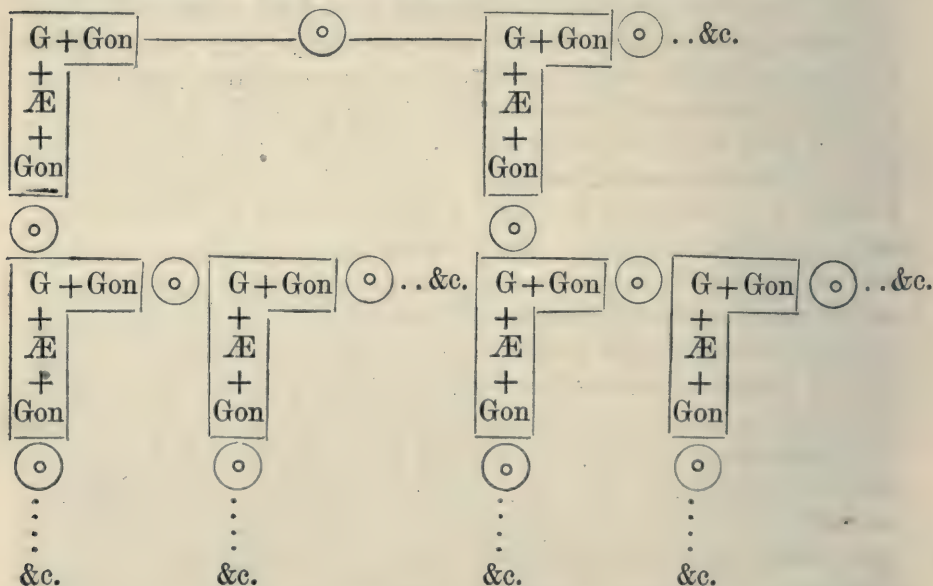
Though the phenomena as understood by Haeckel would thus present nothing really at variance with the fundamental principle of the law of alternation of generations, it must be admitted that they are very exceptional. We cannot lose sight of the anomalous fact that the medusoid elements in each period are not only dissimilar, but, according to Haeckel's view, are both properly sexual. A question, however, here suggests itself, Is it necessary to adopt Haeckel's interpretation of the phenomena? I believe not; on the contrary, I am strongly of opinion that the *Geryonia* is not a sexual Medusa at all, and I believe that the same may be asserted of the *Cunina*. Some years ago †, I insisted on the non-sexuality of those gymnophthalmic Medusæ which, like *Obelia*, *Eucope*, *Thaumantias*, &c., carry their genera-

* Wiegman. Arch. 1861. † Annals of Natural History, November 1859.

tive sacs upon the radiating canals; and I pointed out that the structure of these sacs was identical with that of the gonosacs of *Clava*, *Hydractinia*, &c., thus showing that they are definite zooids produced by a process of budding from the gastrovascular system of a properly non-sexual Medusa*.

This view I endeavoured further to develope in a subsequent paper†, when I designated such non-sexual Medusæ by the name of "gonoblastocheme," showing that they must be carefully distinguished from the proper sexual Medusa such as we meet with in *Sarsia*, *Oceania*, *Bougainvillia*, &c., and for which I proposed the name of "gonocheme."

Now, I believe that the flat leaflike pouches in *Geryonia* are entirely homologous with the more prominent generative sacs of *Obelia*; and if so, *Geryonia* must be viewed not as a gonocheme or sexual Medusa, but as a gonoblastocheme or non-sexual Medusa. The nature of the ova- and spermatozoa-producing bodies in *Cunina* is more doubtful; but still I can scarcely hesitate to regard the generative elements as here also produced in true gonosacs of essentially the same form as in *Geryonia*. The doctrine of the gonoblastocheme will thus at once give us the key to the explanation of the apparently anomalous phenomena discovered by Haeckel, and will enable us to express them in the following form, where Gon represents the gonosac.

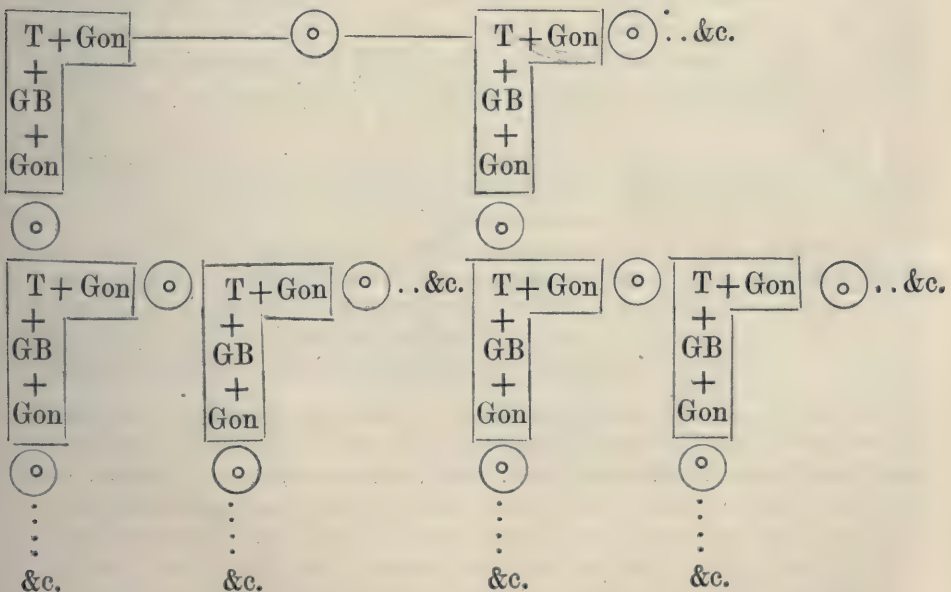


* Leuckart had already recognized the zooidal nature of the generative sacs in *Aglaura* (Wieg. Arch. 1856), and T. S. Wright had expressed an opinion that in every gymnophthalmic Medusa all parts which are borne by the umbrella—manubrium, tentacles, and generative sacs—must be regarded in the light of buds. (Proc. Roy. Phys. Soc. Edin. 1856-57.)

† Report on the Hydroida, Brit. Assoc. Rep. 1863.

I have here assumed, with Haeckel, the direct development of *Geryonia* from the egg; so that *Geryonia*, a non-sexual Medusa, takes the place of a non-sexual polypoid trophosome. But, as already said, there is no proof that *Geryonia* has not originated as a bud from a polypoid trophosome; and if so, G ought to be preceded by T in the above diagram—an addition which would merely increase the polymorphism without affecting the principle.

In no case, however, is the polymorphism of the zooids greater than what is well-known to occur among the Hydroida—as, for instance, in *Campanularia*, where the polypoid trophosome gives origin by budding to a gonoblastidium, and this to a gonoblastochrome, which in its turn develops, by a similar non-sexual act, the sexual bud or gonosac. The form of the diagram of *Geryonia*, however, differs from that of *Campanularia*, inasmuch as *Campanularia* presents a simple linear series, while in *Geryonia*, in consequence of one and the same zooid (the Geryonidan) producing *two* sets of heteromorphic buds (the gonosac and the Æginidan), we have a series presenting two branches, which run off in different directions. This, however, is exactly what occurs in *Hydractinia echinata*, in which the gonosac is borne not only on a gonoblastidium, but also occasionally on the trophosome directly*. This will be at once obvious if the diagram just given be compared with the following, which represents the alternation in *Hydractinia*, and in which the symbol GB is used to indicate the gonoblastidium. It will then be apparent that the two have precisely the same form.



* As pointed out by Dr. T. Strehill Wright (Proc. Roy. Phys. Soc. of Edinb. Nov. 1856).

While Haeckel has thus done good service to our knowledge of the *Hydroida* in pointing out a genetic relation between the *Æginidæ* and the *Geryonidæ*, his labours have been at least as valuable in showing that the structure of the *Æginidæ* is in all essential points identical with that of the *Geryonidæ*. He has proved, for example, that the circular marginal canal, hitherto denied to the *Æginidæ*, is really present; and there can accordingly no longer be any difficulty in placing these Medusæ in the same group with the rest of the Hydroid or gymnophthalmic forms*.

It cannot, however, be overlooked that the position of the *Æginidan* buds is remarkable and anomalous; for they are borne by the solid tongue-like process which in *Geryonia* projects from the base of the manubrium into its cavity. In almost every other known instance the somatic cavity of the Medusa-bud is in communication with some part of the somatic cavity of the Hydroid which produces it, while here such a communication is impossible before the development of the mouth in the bud shall enable the young *Æginidan* to receive nutriment from the stomach-cavity of the *Geryonia*. Three cases, however, all among the *Æginidan* Medusæ†, had been already described, in which the young Medusæ are formed as buds from the internal surface of the stomach-walls, and therefore, just as in the present instance, these young buds could not have had their somatic cavities in communication with that of the animal which carries them. The buds must accordingly have been formed in a very different way from that which takes place in the ordinary cases of budding Medusæ,—so different, indeed, that, were it not for the competency of the observers who have described them as cases of true budding, we should be disposed to regard them as suggesting parasitism rather than gemmation.

* The names of *Cryptocarpa*, Eschsch., *Gymnophthalmata*, Forbes, and *Craspedota*, Gegenb., are each, as is now known, inapplicable to certain members of the group of organisms which they were originally intended to distinguish. The inconvenience, however, arising from this fact may be avoided by the use of the designation *Hydroid Medusa*, which would include under it not only those gymnophthalmic forms which are known to proceed from polypoid trophosomes, but also such as have not been as yet so traced. "Medusa," however, must be understood as a *term* rather than as a systematic name.

† Gegenbaur, in 'Generationswechsel,' p. 56, *Cunina prolifera*; Keferstein and Ehlers, in 'Zoologische Beiträge,' 1861, *Ægineta gemmifera*; and Fritz Müller, in 'Wieg. Arch.' 1861, *Cunina Köllikeri*.

BIBLIOGRAPHICAL NOTICE.

Naturhistorisk Tidsskrift (*Journal of Natural History*), edited by Prof. T. C. SCHJÖDTE at Copenhagen. Third Series, 1861–1864, vols. i. & ii. [O. Rink, *On Watercourses under the Inland Ice in Greenland*; Krøyer, *Contributions to Northern Ichthyology and Contributions to the History of the Parasitic Entomostraca*; O. Mörch, *Revisio critica Serpulidarum*; R. Bergh, *Campaspe pusilla*, n. g. (fam. Dotidæ, trib. Dendronotidæ), and *Anatomy of Sancara quadrilateralis*, n. g. (fam. Pleurophyllidiæ); Meinert, *The Danish Species of Forficula*; J. Fisher, *Observations on Danish Birds*; Schjødte, *The Danish Cerambyces, Larvæ of Coleoptera*, &c.]

SINCE our first notice of this periodical, after its revival by Professor Schjødte (*Ann. & Mag. Nat. Hist.* ser. 3. vol. x. p. 370), the editor has succeeded in completing two large volumes, of 558 and 579 pages of text, accompanied respectively with fourteen and twenty engraved plates—a result which is not only a proof of the editor's zeal and enterprise, but, consisting as these volumes do exclusively of original treatises by Danish authors, also affords a most gratifying testimony to the existence of a vigorous spirit of independent research in the small scientific world of Denmark. Our former notice had reference only to the contents of the first part of the first volume; the contents of the following parts are indicated above. Of Prof. Schjødte's treatise on the Danish Cerambyces, which, perhaps, on account of the truly philosophical handling of the subject, occupies the foremost place, the main part has been translated in the March Number of this Journal, to which we therefore refer, still postponing our notice of the treatise on the larvæ of Coleoptera till the continuation has appeared, which is promised in the first part of the third volume.

The two papers heading the list given above have reference to Greenland, which ever since the days of Otto Fabricius has proved an inexhaustible mine to Danish naturalists. The *terra firma* of Greenland certainly offers but little reward for the explorations of zoologists or botanists; but the geographical and geological aspect of the country has many points of interest, whilst the sea literally teems with fishes and other marine animals.

Mr. Rink, the author of the first-mentioned paper (vol. i. part 2, 1862), is well known to English arctic explorers, and has had great opportunities of study during his long stay in Greenland as a government inspector. The question he proposes to solve is this:—What becomes of the great quantity of water generated by the melting, during the summer, of ice and snow in the interior of Greenland? The numberless rivers or “elv”s in the islands and peninsulas along the shore drain merely these outlying parts; and although some of these small rivers, rising in the peninsulas, may to some extent be fed from the ice of the interior, yet by far the greater part of the water there accumulated must find some other outlet. It is obvious that the icebergs carry off a part in the shape of ice, but it is easy to

see that only the smaller portion can be thus accounted for. The whole area of Greenland is estimated at 16,000 Danish square miles (one Danish square mile equalling about 23 English square miles), of which 10,000 are supposed to lie on the western slope of the central chain of mountains. If, now, a line is drawn along the heads of all the great fjords or bays, this will cut off the islands and peninsulas (altogether about 1600 Danish square miles), leaving more than 8000 square miles as the extent of inland ice west of the supposed central chain. The number of ice-fjords, or bays in which the inland ice reaches the sea and breaks up into icebergs, does not exceed fifteen, of which many evidently correspond to inland valleys of but moderate extent, whilst the large ice-fjords must correspond to valleys so extensive that, in southern latitudes, they would feed rivers as large as the Thames. Assuming that, in Greenland as elsewhere, only one-third of the rain and snow would be carried into the sea by the rivers, and assuming also the rain (snow)-fall to be, at an average, all over Greenland only one-third of what it is in Julianehaab (that is, about 12 inches), there would nevertheless be water enough left to form considerable rivers. But, however difficult it may be to calculate accurately the quantity of ice floating out of a large ice-fjord in the course of the year, the calculation may be carried far enough to show that it cannot represent more than a fraction of the water which, somehow or other, must be carried into the sea from the interior. From this consideration Mr. Rink concluded, long ago, that there must be large rivers at the bottom of these valleys, draining the inland ice which fills up the valleys, hides these rivers, and gives to the interior of Greenland the false aspect of a plateau. These hidden rivers of course terminate at the true heads of the fjords, which, however, cannot be observed closely, because the glaciers or outrunners of the inland ice reach so far into the fjords that their fronts, though only about 100 feet above the water, have nevertheless often 1000 feet real height, the remainder being concealed in the deep water in which the head of the glacier is suspended, gradually advancing, and breaking up. If this supposition is true, the fresh water must be expected to rise in the fjord in front of the glaciers; and this is actually the case. At a little distance from the extremity of the glaciers, there is invariably a place where the water is very much disturbed, bubbling and whirling; and clouds of gulls are continually hovering over these places and diving for prey. The Greenlanders call these places "springs;" and that their true nature is as supposed by Mr. Rink seems to be shown by the existence, at the Godthaabs Fjord, of a freshwater lake, an English mile in diameter, at some distance inside the edge of the glacier, which periodically, though not regularly, fills and empties itself. When it is filling, the nearest springs in the fjord are comparatively inactive, but when it empties itself (generally very suddenly) the movement in the sea is so much increased that it is perceptible as far down the fjord as 13 English miles from the glacier.

The same phenomenon of a lake periodically emptied through canals in the ice has been observed at Sermiliarsuk and Nasarlik,

two ice-fjords under 61° and 62° ; but there, as elsewhere, it is impossible to approach the "springs" in boats, on account of the falling ice. Mr. Rink adduces several other considerations in favour of his view, —for instance, that the thickness of the ice in the valleys of the interior in many places must reach 1000 to 2000 feet, and consequently prevent the freezing of the water at the surface of the earth; that the only reason why the glaciers on the islands and the peninsulas do not reach the sea, and cover the rivers, as the inland ice does, is the small extent of the valleys in which they are formed, &c. But this must suffice to show the bearing of his views and the arguments by which they are supported. Two maps accompany the treatise, both designed and engraved by a Greenlander.

Dr. Kröyer's paper on the Greenland species of *Liparis*, *Gymnelis*, *Lumpenus*, *Lycodes*, and *Stichæus* must, to some extent at least, be considered as an instalment of those descriptions to the plates of Gaimard's 'Voyage en Scandinavie' which are not found in the text of that work, but which Dr. Kröyer has intimated his intention of communicating through the 'Naturhistorisk Tidsskrift.' Of the fourteen species here described, nine are illustrated in Gaimard's work. The descriptions of all, being given in Latin, with the author's usual care, require no further commentary; and we need hardly do more than enumerate them. Of *Liparis* Dr. Kröyer mentions five species as belonging to Greenland—*L. Fabricii*, Kr., *L. tunicata*, Reinhardt, *L. Montagui*, Don, *L. lineata*, Kr., and *L. Reinhardi*, Kr. The last of these has been described by Reinhardt, sen., who has contributed so largely to the Greenland fauna, as *L. gelatinosus*, and as identical with the species described as *Cyclopterus gelatinosus* (from Kamschatka) by Pallas. Dr. Kröyer, however, is of opinion that Pallas's species is altogether distinct, although it agrees with the one described by Reinhardt, and which Kröyer proposes to name *Reinhardi*, in certain peculiarities which remove them both so far from all other species of *Liparis* as to necessitate the formation of a new genus, for which the name *Careproctus* is proposed. These peculiarities consist in the smallness of the sucking-disk, the place of the anus much nearer the mouth, entailing a different shape and position of the inner parts, the shape and position of the pectoral fins, &c. *Gymnelis viridis*, O. Fabr., appears to be one of the commonest fish in Greenland, but does not even reach Iceland or the shores of Hudson's Bay. Dr. Kröyer mentions four species of *Lumpenus* from Greenland, viz. *L. aculeatus*, Rhdt., *L. gracilis*, Rhdt., *L. Fabricii*, Rhdt., and *L. medius*, Rhdt.: he preserves the genus *Lumpenus* as distinct from *Clinus*, though its original characters have proved rather vacillating; but he has not adopted the division of it (proposed by the American ichthyologist Gill, without indication of characters) into three new genera, *Leptoclinus* (*L. aculeatus*), *Centroblennius* (*L. gracilis*), and *Lumpenus*. Dr. Kröyer observes, however, that Reinhardt, sen., has shown long ago (Transactions of the Royal Danish Society, division of Natural History, vol. vii.) that the species may be distributed into three groups (with which Mr. Gill's new genera coincide), according to whether they have merely maxillary teeth or

palatal teeth as well, &c. Dr. Kröyer doubts the identity of *L. nebulosus*, Gill, and *L. gracilis*, Rhdt., but vindicates, in case they should prove identical as Mr. Gill supposes, the right of priority of Reinhardt's name. For the sake of comparison, Dr. Kröyer introduces a definition of *L. lampetræformis*, Wahlb., from Iceland. Of *Lycodes*, Rhdt., Dr. Kröyer describes two species from Greenland, *L. perspicillum*, Kr., and *L. nebulosus*, Kr., which he had shortly indicated already in 1844: three Greenland species had been described before by Reinhardt (*L. Vahlü*, *L. reticulatus*, and *L. seminudus*); so that now five species are well established. The paper concludes with a careful diagnosis of the genus *Stichæus* proposed a long time ago by Reinhardt, and descriptions of two species, *S. præcisus*, Kr., and *S. punctatus*, Fabr.

Dr. Kröyer's paper on "Parasitic Entomostraca" (volume ii. Nos. 2 and 3, 1863-1864, p. 75-426) contains the descriptions of nearly one hundred new species, illustrated by eighteen plates, and is, in fact, a kind of supplement to the treatise published by him about twenty-seven years ago in the earlier volumes of the 'Naturhistorisk Tidsskrift,' whereby he gained so prominent a place as an authority on the history of these curious animals. An enormous amount of material has accumulated since then in the Museum of which Dr. Kröyer has the charge; and although other naturalists in the mean time have described some of these new species, a considerable quantity is still left for Dr. Kröyer to publish. The author still retains Milne-Edwards's classification in its main points; he acknowledges that a reform is necessary, but looks to the ability of the celebrated French naturalist for the accomplishment of this task. He reminds us that Milne-Edwards himself has indicated such improvements as the union of Copepoda and Siphonostoma, and makes use of the opportunity for praising the truly scientific spirit in which great savans, the pillars of science, often abstain from reforms, of which they discern the principles and outlines, but for which the proper time has not yet arrived, thus preferring rather to serve the good cause loyally than to get honour to themselves by perhaps plausible but immature reforms. Dr. Kröyer's expressions on the mania for new systems are worth quoting. He alludes to the German proverb, "When the kings are building, the carters are busy," and says, "that many zoologists seem to have taken a fright lest they should be accounted mere scientific carters if they confine themselves to descriptions. In order to gain for themselves a higher rank, they all make systems, or at least stick some rag of systematic purple to their descriptive papers. The crowd of systems, one more deformed than the other, is so overwhelming that one is tempted to say with Juvenal, 'Semper ego auditor tantum nunquamne reponam?' and to make systems one's self, merely in revenge." It is indeed but too true that naturalists of a certain school, carrying their abhorrence to mere specialities too far, seem to forget that the only solid foundation of all science is accurate description of careful and well-planned observation; that when the phenomena are accurately observed in all essential points, and not till then, the true theory suggests itself;

but that to observe accurately, to direct the observation to the really essential points, and to describe perfectly are the most difficult of all arts. Dr. Kröyer rejects the distribution of Copepoda, proposed by Professor Steenstrup and Dr. Lütken (in the Transactions of the Royal Danish Society of Sciences, division of Natural History, fifth series, fifth volume, 1861), into three groups according to whether the females have but one external oviduct, or two such containing rows of round eggs, or, finally, two external oviducts containing but one row of disk-shaped eggs. To this classification Dr. Kröyer very properly objects that the groups thus formed do not correspond to any typical or important peculiarities of structure, nor does it even fulfil the requirements of a mere registration of species, as it applies only to the females, and as there are not a few Copepoda without any external oviducts at all. It may indeed be said with good reason that the males, preserving as they do the original type more purely, would afford better characters for groups and genera than the females, of which the often monstrous deformations are chiefly dictated by biological considerations. Dr. Kröyer, in speaking of Lernæopodina, points out how well the generic types within that group are exhibited by the males, and he insists more than once on the merely temporary character of systematic divisions founded on females only. With regard to Thorell's proposition (in the Transactions of the Royal Swedish Society of Sciences) for a division of the whole order, which he calls Copepoda, into Gnathostoma (with free mandibles), Pœcilo-stoma (without mandibles), and Siphonostoma (with mandibles enclosed in a tube), Dr. Kröyer acknowledges that it proceeds on sound principles, but considers that our knowledge of this order is still too limited as yet for the carrying out of such a classification. Faithful to his principles, the author limits himself entirely to descriptions and subordinate points of classification. For the use of those who are not conversant with the Danish language, there are very full Latin extracts of descriptions, definitions of new genera (of which nine are proposed), and also a Latin explanation of the plates. We shall draw attention to a few particulars. The number of newly described species is ninety-six, of which one has been named by Fabricius *Condracanthus radiatus*, F.; one, *Peniculus clavatus*, may coincide with Müller's *Lernæa clavata*; thirteen others have been obtained by exchange from the Museum of Vienna, named, but not described by Kollar, whose names have been preserved; eighty-one are collected and named by Dr. Kröyer. It may not be superfluous to observe that the species described in this paper as new do not coincide with any of those described by Professor Steenstrup and Dr. Lütken, except in the case of *Silenium polynoës*, Kr., identical with *Herpyllobius arcticus*, Str., which latter name will have to be cancelled, as the whole description, &c., is founded on an unfortunate fundamental mistake. Dr. Kröyer opposes the theory of Zenker, that *Argulus* should either be united to Branchiopoda or form a separate order; and his views concerning the homologies of the appendices seem to remove the principal difficulties in the way of deciding the place of *Argulus* in the system. What Milne-Edwards describes as "un

appendice sétacé et grêle" of the hook-shaped antennæ is for Dr. Kröyer the first pair of antennæ, removed further back; and the hook-shaped organs described by Milne-Edwards as the sole pair of antennæ Dr. Kröyer consequently describes as a second pair. These organs correspond in shape and place entirely with those organs in *Caligus* which in Milne-Edwards's description are counted as the first pair of footjaws; and Dr. Kröyer therefore, in opposition to Milne-Edwards, describes them as a second pair of antennæ also in *Caligus*. What Milne-Edwards describes in *Argulus* as "une seconde paire d'appendices antenniformes" represent, according to Dr. Kröyer, the first pair of ordinary feet, occupying a place somewhat more advanced and removed to the sides away from the mouth than in *Caligus*. The correctness of this view is confirmed by the circumstance that the sucking-cups which immediately follow them, evidently, as the development of young *Argulus* and the analogy of *Gyropeltis* show, correspond to the second pair of feet in *Caligus*. The author considers the fork-shaped organ observed in *Caligus* behind this thick second pair as a deformed pair of feet, so much the more as it is supported by a separate and independent joint of the body. Both *Argulus* and *Caligus* will thus appear to have seven pairs of feet, exhibiting a strict parallelism. The so-called tail in *Argulus* corresponds, according to Dr. Kröyer, merely to the so-called genital joint in *Caligus*, containing as it does the organs of generation: the real tail is quite rudimentary in *Argulus*, but is nevertheless represented—namely, by the appendages described by Milne-Edwards as "une paire d'appendices de forme ovale" (p. 443). In conclusion, the author adduces the circumstance that the sting placed in front of the beak in *Argulina* has nothing to do with the organs of the mouth, but is rather to be compared to the poisonous sting of *Cyclopsine Castor*, &c.; that several Siphonostoma, such as *Noto-delphe* and *Doropygus*, resemble *Argulus* in being without external oviducts; and that the single eyes placed in a triangle are met with both in free Copepodes (*Sapphirina*) and in larvæ of the parasites, from all of which he concludes that there is no reason for making a new order of Argulini, or separating them from Siphonostoma. He describes three new species of *Argulus* from America, raising the number of species in the group of Argulini to thirteen, of which eleven are American—from which it should seem as if it belonged principally to the New World.

There are, upon the whole, a great many American species amongst those which are described in this paper; and in mentioning three new species of *Chondracanthus* from Valparaiso, the author alludes to a parallelism, observed by him before, between the fauna of North Europe and of the littorale of Chili. Dr. Kröyer abandons as untenable, on account of intermediate forms (of which he describes some, particularly *Alebion Carchariæ*, Kr.), the distinction between Caligini and Pandarini. He preserves the genera *Lepeophtheirus*, Nordm., and *Sciænophilus*, Van Ben., which Steenstrup (*l. c.*) has proposed to suppress; but prefers to reunite *Calistes*, Don., and *Dysgamus*, Steens., with *Trebius*, Kr. (*Synestius*, Steens.), and *Parape-*

talus, Steens., with *Caligus*. There are several interesting observations on the development of Caligini. At first the young larvæ have only two pairs of appendages; but after changing skin their form becomes more elongated, and they acquire a third pair; they go, probably, through a further series of transformations before fixing themselves, but these are at present unknown. Of several species the Chalimi or fixed larvæ have been observed—those of *Lepeophtheirus Hippoglossi* through three different stages. In the first stage (length $\frac{5}{8}$ ''') the genital joint showed two pairs of appendages, or perhaps one double-oared pair; in the second stage (length $1\frac{1}{4}$ ''') these appendages had disappeared, the genital joint and the tail were still shorter in proportion to the fore part of the body, the "fork" was not yet visible; nor could this be observed in those belonging to the third stage (length 2'''). As, however, the smallest adult females are 5''' long, several transformations are still to be observed. Dr. Kröyer's observations on the Chalimi of *Caligus curtus*, *C. Gurnardi*, and *Trebius caudatus* were quite analogous. Of *C. Cheilodactyli* larvæ were observed very nearly of the same size as the adults. Neither of the "fork" nor of the generative organs was the least vestige distinguishable; but the sucking-cups had begun to form themselves. The organ of fixation, which does not grow in proportion with the larva, and of which the place is discernible in all adult *Caligi* just behind the frontal emargination, shows rather a complicated structure, and distinct variations in different species, so that these may be recognized by it. The young of *Læmargus muricatus* and *Cecrops Latreilli*, which have been observed shortly after assuming the adult form, show some remarkable differences, particularly in the fact that the same piece which in adult Caligini is described as the frontal piece presents itself here as a distinct *ocular segment* or joint, which afterwards disappears, principally owing to the growth of the second pair of antennæ: it exhibits two rather large eyes, which of course disappear with it. To this ocular segment the remains of the organ of fixation were attached, proving that this segment corresponds to the frontal piece of an adult *Caligus*, though this never carries eyes. In the structure of the adult Caligini certain diminutive spines on the concave side of the second hook-shaped antennæ, as well as on the hooks of the second pair of feet, and which are in connexion with extensive glandular (poisonous?) apparatus, may be particularly mentioned. The glands which feed the hooks of the second pair of feet are situated close under the dorsal shield, and are particularly easily distinguished in *Læmargus*, where they have a milky colour, and shine through the shield. Their structure is convoluted; and Dr. Kröyer has followed their ductus, which forms a larger reservoir in the claw itself, to their termination in a very diminutive spine on the concave side of the hook. Dr. Kröyer also recommends *Læmargus muricatus* for observing the copulation. As is well known, the males remain attached to the female even after death, by means of their hooked antennæ and feet; nor would a less secure adhesion suffice, for the work of protruding the spermatophores, and fixing them, one to each of the

vulvæ, takes a long time. At the conclusion of his paper Dr. Kröyer describes three dubious animals belonging to the class of Entomotraca, of which particularly one, named *Pegesimallus spiralis*, is so different from any known genus, in some respects reminding one of the Annelide type, as fairly to puzzle the most ingenious divination.

The habits of the common Earwig, principally known from the work of De Geer, have been made the subject of renewed investigation by Dr. Meinert. According to his observations, the eggs (30-70) are laid in the autumn, as early as the beginning of October, though in some cases only in the following spring. They are placed all in a heap under bark or stones, in holes often dug by the mother, who places herself over and defends them in danger. Dr. Meinert found that when he dispersed the heap the mother collected it again; and once he saw an earwig covering with her body a hole filled with quite young larvæ, and keeping at bay for a considerable time a party of yellow ants which had got access to her hiding-place on the removal of the protecting stone. Although earwigs do occasionally use their forceps for pinching, and with no mean force, this did not constitute her mode of defence; but whenever the ants in crawling about came near the extremity of the forceps, she hurled them away by a quick movement of that organ. At last she was obliged to leave her brood in the power of the ants. Another time Dr. Meinert had three female earwigs, each with a young family, in captivity under the same shade: two of the mothers having been removed, their young sought and received protection from the third and remaining; but when she also had been removed, they all separated and made good their escape. The larvæ appear in the spring, and have generally six-jointed antennæ; some however have eight joints in their antennæ, even before leaving the egg, in which case Dr. Meinert supposes that the first change of skin has taken place in the egg, as the points of the tarsi and palpi were found encased in a loose membrane. The skin is changed several times, the third joint of the antennæ each time dividing itself into three new joints, so that the number of joints is increased with two each time; the pupa has twelve, the imago fourteen joints. The cases in which the wings of the imago are formed in the pupa are coalescent along the middle. Both larvæ and pupæ possess a pair of large fœtid glands, of which the ducts terminate at the root of the forceps, one on each side; they are largest in the pupa, but disappear in the imago, where they are replaced by two pairs of smaller flat glands, of which the external orifices are situated at the back of those small knobs or ridges observed by Léon Dufour and Westwood on the second and third dorsal segments. The only external distinction between the sexes in the pupa consists, according to Dr. Meinert, in a light-coloured line along the middle of the 7th and 8th ventral segments in the female; and Fischer's statement, that even in larvæ and pupæ the sex may be recognized by the number of joints in the abdomen, is therefore erroneous. Dr. Meinert asserts that this number is the same in both sexes, as numerous dissections have proved to him. He has also observed the copulation, which is performed in a curious manner. The male is not on

the back of the female, but behind her; and the position of the two parties is such as if the male had originally been on her back, but had fallen off on his own back. If one of them stands on the ground, the other lies on its back; the act can therefore only be performed between loose bark and the wood, or in other such localities, where they can fix themselves in inverted position to opposite surfaces, blades of grass, leaves, or other points of support. Dr. Meinert has several times seen it performed, and always in such positions. He denies that the forceps are used *in copulâ* for any purpose; they are simply laid along the respective ventral surfaces. He affirms that earwigs, compelled by hunger, attack and devour one another. The number of abdominal segments in *Forficula* has been very differently stated by different authors, and is of importance with regard to the question whether the abdominal segments in insects exhibit a constant number and homologous parallelism in their modifications, particularly in the service of generation. Dr. Meinert maintains that the number is the same in both sexes and in all stages of development—namely, nine besides the segmentum mediale (Schjödte, = segment médiaire, Latreille), which in the larvæ is only represented by a dorsal shield, and which Dr. Meinert considers to be the true first abdominal segment—a necessary consequence of Prof. Schjödte's discovery of the true stigmata mesothoracica in Hymenoptera*. The apparent sexual difference of two abdominal segments less in the female than in the male,

* The principal objection to Latreille's theory of the segment médiaire was hitherto afforded by the position of the large spiracles at the back of the thorax of Hymenoptera, which were always counted as the second pair. But since Prof. Schjödte has discovered the true second pair in the same place as in Coleoptera, behind the epimera mesothoracica, where they are easily overlooked, as they are open only during the flight, this objection has been completely removed. The large spiracles in question in the so-called metathorax of Hymenoptera evidently correspond to those found in Coleoptera between metathorax and abdomen, and which Schjödte prefers to call spiracula metathoracica (not abdominalia 1^{me} paris), because their structure and size principally depends on the development of the organs of the thorax, particularly of the elytra. According to Schjödte, the whole matter stands thus:—The first abdominal segment develops itself differently from the neighbouring segments according to the following rule:—

1. The ventral shield is reduced in size in proportion as the third pair of legs become more powerful, because the coxæ, as they increase in size, absorb a proportionate part of the space which otherwise would be occupied by the first ventral shield. In some cases even a couple of the following segments are similarly reduced.

2. The dorsal shield of the first segment of the abdomen (segment médiaire, Latreille; segmentum mediale, Sch.) consequently alone remains, filling up the space above the third pair of coxæ, and necessarily conforming to the hind part of the thorax in shape and size. Another necessary consequence of the rudimentary state of the ventral shield of the true first segment of the abdomen is this—that, in the case of an abdomen petiolatum, the petiolus is formed by the *second* abdominal joint; and the thinner the petiolus is where it articulates on the first abdominal joint, the more must this first segment (segmentum mediale) separate itself from the abdomen and unite itself to the thorax.

Dr. Meinert explains by the supposition that the vagina has been placed behind the sixth instead of behind the eighth ventral shield; and he considers certain chitinized parts between the vagina and anus as the vestiges of the reduced seventh and eighth ventral shields, the lateral parts being more clearly discernible than the central ones. Of course the dorsal parts of these segments must be similarly reduced. The two triangular plates which Mr. Westwood explains as the bifid last ventral shield are explained in the same way by Dr. Meinert, who counts them as the ninth ventral. They are to be found not only in the female, where Mr. Westwood discovered them, but also in the male, partly hidden by the ventral shield of the eighth segment. This view differs from that of all other authors, also from that of Lacaze-Duthiers, whose whole account is vitiated by the strange mistake of counting seven whole segments in front of the vagina, whereas there are only six. Duthiers's last dorsal shield, "endecato-tergite," first observed by Léon Dufour, is, according to Meinert (who proposes to call it the "anal" plate, and recommends it for the distinction of species), only a chitinized part of the membrane extending between the roots of the forceps; it consists of two parts. The Latin *résumé* at the end of this paper contains the results of the author's careful investigation of the sexual organs of the male, and there is also a Latin explanation of the plate which illustrates their structure.

M. Mörch's revision of Serpulidæ has been occasioned by, and is in fact a kind of necessary supplement to his paper on Vermetidæ (Proc. Zool. Soc. 1861-1862). The similarity between the shells is so great that hardly any character can be considered unconditionally reliable for their distinction. *Dentalium* has an anal orifice, as well as any Annelid; and though the opaque cretaceous shells of most Serpulidæ may be easily distinguishable from the internally smooth and shining shells of most Vermetidæ, the semitransparent shells of several species of *Placostegus*, *Ditrypa*, and *Spirorbis* have a parallel in that of *Siphonium Gæderopi*, at least in young specimens. Neither sculpture, nor shape, nor colour distinguishes the shells sufficiently well, nor does the assumed constant absence of internal transverse divisions; for they are, as Professor Steenstrup has shown, to be met with in *Spirobranchus*—only in this latter they are perforated, and are soon destroyed when a new one has been formed, so that not more than one is observable at a time. One hundred and thirty-four species are described in Latin, amongst which several new ones, besides a new genus, *Phragmatopoma*, of the family of Hermellæ, which has been described here because it shows some analogy to Serpulidæ, and seems to exhibit a transition from the type of one group to that of another. The paper is accompanied with a very beautiful plate.

In conclusion, a few words may be said on Dr. Bergh's papers, of which the first describes a new genus of Dendronotidæ, which he proposes to call *Campaspe pusilla*, differing from *Dendronotus* principally by the trunks of the dorsal papillæ and the sheaths of the rhinophores being but slightly subdivided, as well as by its teeth. To this is appended an anatomical description of *Doto*, showing, amongst

other things, in opposition to the statements of Souleyet and of Alder and Hancock, that it does possess jaws, which have been overlooked by these authors on account of their being almost colourless, just as they were overlooked by Burmeister in *Phyllodesmium*, where Dr. Bergh has proved their existence on an earlier occasion. The same circumstance has caused Alder and Hancock to overlook the teeth, which are arranged, not as in *Glaucus*, but as in *Dendronotus*, only there are not so many as in *Dendronotus*. Dr. Bergh's second paper gives a careful diagnosis of the family of Pleurophyllidæ, of which he describes a new form, *Sancara quadrilateralis*, Bgh., particularly distinguished by the rhinophores being foliated only on one side. Of this new genus the author gives an anatomical description occupying forty pages, with two plates, of which we shall mention a few details. Dr. Bergh has found spicula in the envelope of several Pleurophyllidæ which were formerly supposed not to possess them. He carefully describes the jaw, which is very like the basal part of the jaw of *Æolidia*, but exhibits nothing parallel to its broad lamelliform part. The outside of this jaw was covered with a peculiar membrane (showing cellulae of irregular shape, and mostly placed in quincunx, with a clear nucleus)—a covering which the author says that he has found on the jaws of many *Æolidiæ*. The structure of the mouth was like that of *Æolidia*; but the account given of this by Dr. Bergh differs considerably from that by Alder and Hancock. The principal divisions of the liver, after having given off branches to the side folds, seem, according to Dr. Bergh, to terminate near the edge of the mantle, near the urticating cells, which consequently are here placed in the same near vicinity to the last ramifications of the liver, in which Dr. Bergh had discovered them some years ago in *Æolidiæ*. The organs of generation are hermaphroditic, as in all Pleurophyllidæ, those of the different sexes united into one gland.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

Dec. 13, 1864.—John Gould, Esq., F.R.S., in the Chair.

CHARACTERS OF NEW SPECIES OF CRUSTACEANS DISCOVERED
BY J. K. LORD ON THE COAST OF VANCOUVER ISLAND.
BY C. SPENCE BATE, F.R.S.

[The following new species of Crustaceans, collected on the east side of Vancouver Island, were kindly named, described, and figured for me by Mr. Spence Bate. Some of them were dredged in from 8 to 10 fathoms of water; the rest were collected between tide-marks.

Mr. Spence Bate says, in speaking of the collection generally, "The extremely opposite and varied localities in which many of the species here represented have hitherto been found, suggest the idea that Vancouver Island corresponds with the extreme limit between a

northern and a tropical fauna." "It is only in this way I can account for finding the representatives of tropical species, with others that are found only (on the eastern coast of Asia) in the Arctic and, perhaps, North Atlantic Oceans." That he is quite correct in this assumption I think there can be little, if any, doubt; for not only does it apply to the Crustaceans, but with equal force to the Molluscan groups. Several new species of shells, collected at the same time and in the same localities as the Crustaceans, which were named and described by Dr. Baird, with appended notes by myself, and published in the Society's 'Proceedings' of last year, are identical in some cases, in others closely allied to known species from Japan, Australia, and the north shores of our own island.

The tidal irregularities of this coast are perfectly inexplicable. In May, June, and July, during the twenty-four hours there is but one high and one low water; at the change and full of the moon, high tide happens near midnight, and varies but little as to time during the three months. In August, September, and October there are two high and two low tides in the twenty-four hours. Then in the winter months, November, December, and January, the regular twelve-hour tides recur; but high water is at twelve in the day, instead of twelve at night. The spring tides range from 10 to 12 feet, the neaps from 5 to 8.

The temperature of the sea taken during the summer months near the surface ranges from 52° to 56° F. The sea-water seldom, I may say never, looks clear, but always presents a turbid muddy appearance, as if a large quantity of sand was mixed with it. This may in some measure be accounted for by assuming that strong undercurrents flow from north to south, and, sweeping past the island and being (from their high specific gravity) close to the bottom, stir up the sand and mud. The sea-bottom in and adjacent to the numerous bays, harbours, and long canals which, like the fiords of Norway and Sweden, everywhere intersect the mainland and island coasts, varies in accordance with the character of the bounding rocks: where trap, soft clay-slates, or felspathic rocks form the coast-line, a thick blue clay is the usual bottom; where grits and sandstones, there it is sandy.

Little, if indeed anything, is as yet known of the deep-sea productions from the west side of the island, which will afford a rich harvest to future explorers.—J. K. LORD.]

PUGETTIA LORDII, n. s.

Carapace quadrate behind the orbits; the anterior portion abruptly narrowing and produced into a double rostrum, the horns of which divaricate. The anterior extremity of the orbital margin is produced to a sharp point, that is elevated slightly above the beak; the posterior extremity is defined by a distinct fissure. The anterior hepatic region is produced by a tooth immediately posterior to the postorbital fossa, laterally extended to an obtuse tooth or point, and posteriorly separated from the branchial regions by a decided fossa or lateral constriction. The branchial region is late-

rally produced to a strong anteriorly-curved point. The dorsal surface is tolerably smooth, exhibiting but faintly the marking of the internal viscera. The eyes are small, and reach but little beyond the orbital margin. The external antennæ have the first joint fused with the carapace, the second and third compressed and arcuate, and terminate in a smooth flagellum. The first pair of pereiopoda are moderately long, having the meros triangulate, the upper angle forming a prominent carina that extends along, but terminates abruptly a little short of both extremities of the joint; the carpus is tricarinated; the propodos is laterally compressed, and forms about half the length of the limb, and is about one-third of its breadth. The dactylos is slightly curved and slightly serrated on the inner margin, and antagonizes at the extremity with the produced propodos. The second pair of pereiopoda are nearly as long as the first, but much more slender, having the meros and propodos subcarinated. The three posterior pairs are shorter. The pleon is small and narrow, the second and third segments being the broadest, while the seventh is abruptly narrower than the sixth, and forms a triangular plate. The female differs from the male in being more protuberant over the stomachal region, and consequently the rostrum is more depressed; anteriorly, there is less development of the lateral branchial teeth, and there is a relatively greater distance between the fifth pair of pereiopoda. The pleon is almost circular, and covers the entire surface of the ventral region.

The colour of the animal is of a reddish brown, which increases in brightness as it approaches towards the extremity of the chelæ. In one or two young females the carapace was smooth and glabrous.

Found in tolerable abundance in Esquimalt and Victoria Harbours, and, indeed, in all the sheltered inlets along the mainland coasts from the mouth of the Fraser to San Francisco. Dredged in about eight fathoms of water, but easily obtained in pools at extremely low tides. Its favourite haunt is under a large flat stone, or hid under the seaweed that fringes the margin of a pool. The specimen from which the drawing was made was taken in Esquimalt Harbour.

OREGONIA LONGIMANA, n. s.

Carapace coarsely granulated or minutely tuberculated, free from hairs, except upon the rostrum, which is slender and twice the length of the interorbital space. Pleon, in the male, narrow, concave upon each side, corresponding with the fourth, fifth, and sixth segments. Telson rather broader than the preceding segment, and emarginate at the terminal extremity. The first pair of pereiopoda are very long, being twice the length of the carapace, and much longer than in either of the species described by Dana and Stimpson; the meros reaches quite to the extremity of the rostrum, and is furnished with two or more longitudinal rows of small granulated tubercles; the propodos is rather longer than the meros, and its breadth is equal to about one-third of its length; the dactylos is about one-third of the length of the propodos, slightly curved and minutely serrated on the inner margin, which impinges throughout its entire length upon the pro-

duced extremity of the propodos. The three succeeding pairs of pereiopoda are imperfect in the only specimen procured; but the last pair are long, cylindrical, slender, and terminated by a powerful dactylos.

This specimen was obtained in Esquimalt Harbour, and in its habits and general distribution it is very similar to the preceding.

PLATYCARCINUS RECURVIDENS, n. s.

This very pretty species may easily be distinguished by the sharp points of the inner lateral teeth, granulated or minutely baccated along the margin, and having the apex recurved. The intraorbital margin is three-lobed and granulated, the central lobe being the smallest. The dorsal surface of the carapace is granulated on the prominent lobes in the larger specimens, but almost smooth in the young. The first pair of pereiopoda have also lines of granulations along the outer surface of the propodos and carpus.

Dana has merged this genus into that of *Cancer*; but the greater length of the animal in relation to its breadth is a very convenient generic diagnosis, and one that appears to correspond with Milne-Edwards's description relative to the more longitudinal position of the two pairs of antennæ.

The specimens were obtained in Esquimalt Harbour. It frequents pools between tide-marks; but Mr. Lord thinks it is common everywhere along the Oregon coast.

CHLORODIUS IMBRICATUS, n. s.

Carapace having the posterior portion smooth, the anterior being rough with flattened prominences that form an irregularly imbricated surface. Anterior margin slightly baccated. Antero-lateral margin five-toothed, the central tooth being the largest, the posterior the most prominent. A small secondary tooth stands upon the anterior surface of the fourth and fifth teeth. The first pair of pereiopoda are short and robust; they have the carpus deeply corrugated upon the external surface, so also the propodos; the dactylos is ribbed upon the upper surface; a slight rib is also present upon the carpus of each of the four succeeding pairs of pereiopoda.

Only a single specimen of this pretty little species was obtained. It was dredged in about eight fathoms of water in Esquimalt Harbour.

CRYPTOLITHODES TYPICUS.

Cryptolithodes typicus, Brandt, Bull. de l'Acad. de St. Pétersbourg, 1849, vii. 175; Stimpson, Crust. & Echin. of Pacific North America, Journal of the Boston Soc. of Nat. Hist. vol. vi. p. 472, pl. 20.

A specimen of this species, which was first described by Brandt, and afterwards more fully, as well as figured, by Stimpson, was taken in Rosario Strait, Vancouver Island, as well as in Upper California.

The male, which has not hitherto been described, differs from the female in being less produced posteriorly. The posterior margin, instead of being projected in an arch inversely corresponding with that of the anterior margin, traverses a line that is nearly direct from

side to side, slightly posterior to the points of the broadest diameter in the carapace. The pleon is triangular, and smaller and narrower than in the female, having the lateral margins more straight and symmetrical.

The only male specimen in the collection is smaller than the female, and the surface generally more tuberculated. The right propodos of the first pair of pereopoda is larger than the left, and is so well developed as scarcely to be capable of being folded within the limits of the carapace. The length of the male animal, from the extremity of the rostrum to the centre of the posterior margin of the carapace, is about $\frac{3}{4}$ ths of an inch; its breadth, from the point of one lateral extremity to the other, is about $1\frac{1}{4}$ inch.

The size of the largest female in the collection is in length about $1\frac{1}{4}$ inch, and breadth about 2 inches.

CRYPTOLITHODES ALTA-FISSURA, n. s.

Female.

This species may readily be distinguished from the two previously known by the smoothness of the carapace, propodi, and pleon, and more decidedly by the deep orbital notch on each side of the rostrum.

The carapace is nearly as broad again as long, and produced considerably posteriorly to the cardiac elevation—a feature that appears to belong to the female. The rostrum is broad, flat, and rectangular. The antero-lateral margins are produced so far anteriorly as to be nearly in a line with the extremity of the rostrum; a deep notch, in which the eyes are situated, exists on each side of the rostrum. The anterior margin is slightly marked with distant small points. The posterior margin is quite smooth and even. The dorsal surface is quite smooth, and pencilled in light red upon a yellowish ground, the red pencilling being fine and delicate, following the contour of the margin and surface of the carapace.

The pleon is subsymmetrical and very smooth, and planted considerably within the posterior margin of the carapace. The second segment (first visible) has the marginal plates fused with the central. The sixth segment is without lateral plates; and the telson is situated beneath, and anterior to, the posterior extremity of the sixth segment.

The eyes are small, and placed upon peduncles that gradually taper from the base to the extremity. The first pair of antennæ are short, and developed upon the type of those of the *Brachyura*; but the first joint is reduced to a size that is only about twice the diameter of the second. The second pair of antennæ are but little longer than the first, and are furnished with a broad round scale at the third joint, and a terminal flagellum that is about the length of the fifth joint of the peduncle. The squamiform appendage is circular and disk-like; the inner margin is straight or somewhat excavated.

The second pair of gnathopoda have the third joint much broader than the fourth (the secondary appendage reaches not to the extremity of the third), and have the terminal joints small and rudimentary. The first pair of pereopoda are subequal in the female, the propodos

upon the right side being somewhat larger than that on the left; the surface is smooth and even, and the dactylos is furnished with a prominent carina that terminates abruptly near the basal articulation, and loses itself gradually towards the apex. The fifth pair of pereopoda are completely hid from view; the three basal joints are short; the two terminal ones subequally long, and furnished with a copious brush of strong cilia. These appendages are folded together and enclosed within the branchial chambers, where they, no doubt, fulfil the office of the flabella of the highest forms of Crustacea—affording an interesting illustration of an organ being converted, by the force of circumstances, from its original purpose to the fulfilment of another, for which it was apparently most unsuited.

PETALOCERUS BICORNIS, n. s.

Carapace triangular, anteriorly produced into two horizontal horn-like processes; tuberculated with nodulated prominences all over the surface, but furnished with a series of large tubercles corresponding in line with the external margin of the carapace; the anterolateral margin constricted between the branchial and hepatic regions, furnished posteriorly to the orbit with two strong, blunt processes, and, posteriorly to the central constriction, armed laterally with two distant narrow processes, and posteriorly with six closely situated, large, round tubercles.

The pleon is nearly symmetrical, being rather larger on the left than the right side. Each segment is defined by a marginal prominence; that upon the left side is continued from near the middle to a process that terminates in a point or tooth at the side, but that on the right becomes confluent with a posterior ridge, and forms an irregular circle, the centre of which is deeply depressed.

The eyes are small, of a green colour, and surmounted on denticulated peduncles. The first pair of antennæ consist of three equal-lengthed joints (of which the first is the more robust), together with a short, stout, pilose flagellum and a slender secondary appendage. The second pair of antennæ have a compound scale, consisting of two large and two short compressed processes, and the third joint is furnished with two or three sharp, strong processes.

The first pair of pereopoda are chelate and strong, echinated with blunt-pointed spines, and terminate in fingers that are flattened at the extremity, and furnished upon the outer surface with numerous tufts of hair, that spring from the summits of the numerous tubercles that are found there. The second, third, and fourth pairs of pereopoda are more slender than the first, resemble one another very considerably, and are furnished with short, sharp, and slightly curved dactyli. The fifth pair of pereopoda are rudimentary appendages; they consist of but five joints, the last of which terminates in a blunt extremity that is furnished with a considerable brush of hair, and is probably used for the purpose of cleansing the branchial appendages.

The pleopoda are present in the female, with the exception of the first pair (which are small) only upon the left side of the pleon, as exemplified in our specimen.

This species differs from White's *P. Bellianus* in having a horizontal bifurcate rostrum to the carapace, being more distinctly tuberculated, and in the pereopoda being more strongly spinated.

This handsome species is of a yellow colour, picked out with purple between the tubercles.

It was dredged in Esquimalt Harbour, in ten fathoms of water.

HIPPOLYTE ESQUIMALTIANA, n. s.

Rostrum as long as the carapace, armed with four teeth at the base, the posterior being just behind the orbits, and the anterior being near the centre of the rostrum, the anterior half of the rostrum being straight and smooth. The inferior margin is excavate at the base, and furnished with seven small teeth, the four posterior being near together and posterior to the centre of the rostrum, the three others being further apart, the most anterior being subapical.

The third segment of the pleon is dorsally produced posteriorly to a point. The eyes are small; the superior antennæ have the primary ramus of the flagellum tolerably robust, and reaching to about two-thirds of the length of the rostrum, the secondary slender and longer than the primary. The inferior antennæ have the scale reaching to about three-fourths of the length of the rostrum, rounded at the apex, subapically furnished with a small tooth upon the external margin; the flagellum (wanting).

First pair of pereopoda short, robust, chelate; second pair long, slender, and chelate; the posterior terminating in a robust dactylos.

Taken in Esquimalt Harbour.

MÆRA FUSCA, n. s.

The body is long and slender; the superior antennæ are about half the length of the animal, the peduncle being scarcely longer than the flagellum, the secondary appendage being half the length of the primary, the second joint of the peduncle being about the same length as the first. Second pair of gnathopoda having the propodos large; palm without teeth, and defined by a small pointed process. Posterior pair of pereopoda having the posterior margin of the base smooth.

In its general appearance this species bears a near affinity to *Mæra grossimana*, as well as to *M. tenella*, from the Feejee Islands, the only appreciable distinctions being in the shorter length of the second joint of the antennæ, the absence of teeth from the palm of the hand in the second pair of gnathopoda, and in the even margin of the last (the only remaining) pair of pereopoda, and perhaps also in the shortness of the peduncle of the ultimate pair of pleopoda.

Only one specimen of this species is in the collection; and that was taken from a sponge dredged in about ten fathoms of water in Esquimalt Harbour. It is of a brownish colour.

JÆRA WAKISHIANA, n. s.

Anterior margin of the cephalon nearly straight; pereion having the sides subparallel, the greatest width being at the sixth segment.

Pleon having a double excavation on the posterior margin, the central point not extending beyond the extremity of the sides. Superior antennæ reaching to the extremity of the fourth segment of the inferior. Inferior antennæ nearly two-thirds the length of the animal. Posterior pair of pleopoda as long as the posterior margin of the pleon, terminating in two styliform rami, each of which is tipped with a few short hairs.

This species was taken from a sponge dredged in about eight fathoms of water in Esquimalt Harbour.

The specific name is derived from the circumstance of the animal having been found in the territory of the tribe of Wakish Indians.

TANAIS LORICATUS, n. s.

The only specimen in the collection is imperfect. The first segment of the pereion appears to be imperfectly fused with the cephalon. Inferior antennæ scarcely half the length of the superior. First pair of gnathopoda having the propodos ovate; dactylos short and tumid, shorter and less pointed than the digital process of the propodos. Pereiopoda having the first three joints short and broad, being affixed to the side of the pereion like plates of mail (hence the specific name); they terminate in short pointed dactyli, and have the propodi armed with two lateral rows of strong, black, pointed teeth.

This species was taken from the hollow of a sponge dredged in Esquimalt Harbour, at the depth of about ten fathoms.

IONE CORNUTA, n. s., Bate.

The male differs from the description of the European species chiefly in having the caudal extremity terminating obtusely, and in having shorter antennæ.

The female has the antero-lateral hornlike process of the cephalon curved posteriorly. The pereion is not quite equilaterally developed. The coxæ of the four anterior pairs of pereiopoda are round, and all attached to the antero-lateral margin of the segments of the pereion. The coxæ of the three posterior are the larger, and produced posteriorly to a point. The pleopoda are long, and fringed with arborescent branchiæ.

This is the only species known, besides that taken by Colonel Montagu on the southern coast of England.

Length, male $\frac{1}{4}$, female $\frac{3}{4}$ of an inch.

Taken attached to the branchiæ of *Callianassa longimana*.

Jan. 10, 1865.—Dr. J. E. Gray, F.R.S., in the Chair.

NOTICE OF A NEW WHALEBONE WHALE FROM THE COAST OF DEVONSHIRE, PROPOSED TO BE CALLED ESCHRICHTIUS ROBUSTUS. BY DR. J. E. GRAY, F.R.S., ETC.

A better proof could not be required of the little attention that has hitherto been paid to the study of the Whales of the seas surrounding the British islands than the fact that, almost immediately after the appearance of my paper on British Whales, in which I had

doubled the number of species that had before been recorded as found on our coast, a bone has been discovered showing most distinctly that a species of Whalebone Whale which had only been described from an imperfect skeleton buried in the sand on the coast of Sweden is also an inhabitant of our seas.

Mr. Pengelly has kindly brought to me one of the middle cervical vertebræ of a Finner Whale, which was washed ashore at Babbacombe Bay, in Torbay, on the coast of Devonshire, on the 24th of November 1861. It is so different in its form and proportions from the cervical vertebræ of any of the species of British Whales which I described in my paper on those animals (printed in the 'Proceedings' of the Society for 1864), that I lose no time in bringing a description of it before the Society; for, as I have already observed, I consider that we must treat remains of Whales as we do fossil animals—describe them from a single bone, if no more can be procured, if, after careful study and comparison, we are satisfied that the bone in question differs in important characters from the corresponding bone in the hitherto known species.

In this case, though as yet we only know a single bone, there cannot be any doubt,—1, that the body of the vertebra differs in its form and thickness from the vertebra of any Finner Whale yet described; 2, that the thickness of the lateral processes is exceedingly different from that of those parts in any other known species; 3, that the size, or rather width, of the canal of the spine, as compared with the size of the body of the vertebra, differs from the width found in any Whale yet examined.

On comparing this vertebra with the drawing of the cervical vertebræ of *Balænoptera robusta*, described by Professor Lilljeborg in his very excellent paper on the Scandinavian Whales, which he had been so kind as to transmit to me, I was induced to believe that the bone sent by Mr. Pengelly might belong to that species; but, for greater certainty, as I cannot read the Professor's Swedish description of the species, nor get it properly translated here, I sent a tracing of the bone to Upsal, and the Professor has replied that he believes that it belongs to the species he described. He has also sent me a drawing of one of the cervical vertebræ of his species, which certainly agrees with the one from Babbacombe Bay in every particular, except in being a trifle larger in all its parts.

The addition of this animal to our marine fauna, and the procuring of the remains of a second specimen of a species which only rested on the description of an imperfect skeleton found imbedded in the sand on the coast of Sweden, is important.

In my "Notes on the Whalebone Whales, with a synopsis of the species," published in the 'Annals and Magazine of Natural History' (vol. xiv. p. 343), I gave the reason why I thought *Balænoptera robusta* was probably more allied to *Megaptera* than to *Physalus*, and I there proposed for that species a new subgenus, under the name of *ESCHRICHTIUS*. The examination of the vertebra from Devonshire and the additional figures which Professor Lilljeborg has so kindly sent to me confirms me in the idea that it is of a distinct

form, proper to be considered a genus. Professor Lilljeborg observes, "Depuis peu vous considérez que mon *B. robusta* appartient au genre *Megaptera*. D'après les principes que vous avez suivis dans la distinction des genres des *Balænoptères*, cette espèce, sans doute, doit faire type d'un genre particulier."

In the cervical vertebræ of all the genera of Finner Whales which I have examined, and which have hitherto been described, the width of the canal of the spinal marrow is rarely more than half the width of the body of the vertebra: thus in *Physalus* the canal is $5\frac{3}{4}$ inches wide, and the body of the vertebra 11 inches; in *Megaptera*, which had the largest and widest canal known until the discovery of this Whale, the canal is 5 inches, and the body of the vertebra 9 inches wide; but in this Babbacombe Whale the canal is $6\frac{3}{4}$ inches, and the body of the vertebra only $7\frac{1}{2}$ inches wide. The cervical vertebræ of the *Balænidæ* have a large canal for the spinal marrow, compared with the size of the body of these vertebræ.

The large size of this canal in *Megaptera*, *Pæscopia*, and *Cuvierius*, as well as peculiarities in other parts of the skeleton in the two former genera, shows that the long-armed Humpbacked Whales have some characters which make them, in some respects, more allied to the Right Whales, or *Balænidæ*, than the other Finner Whales. *Eschrichtius* is separated from both *Megaptera* and *Pæscopia* by the regular and well-developed form of the lateral processes, which are even larger and longer, compared with the size of the body of the vertebra, than are found in any of the species of *Physalus* or *Benedenia*.

The canal of the spinal marrow in *Eschrichtius* is broader, compared with the size of the body of the vertebræ, than it is in the last cervical vertebra of *Balæna biscayensis* (the canal in this species becomes wider, compared with its height, as it approaches the dorsal vertebræ); for its width is only four-fifths of the width of the body of the vertebra, while in *Eschrichtius* it is nine-tenths of the same measurement.

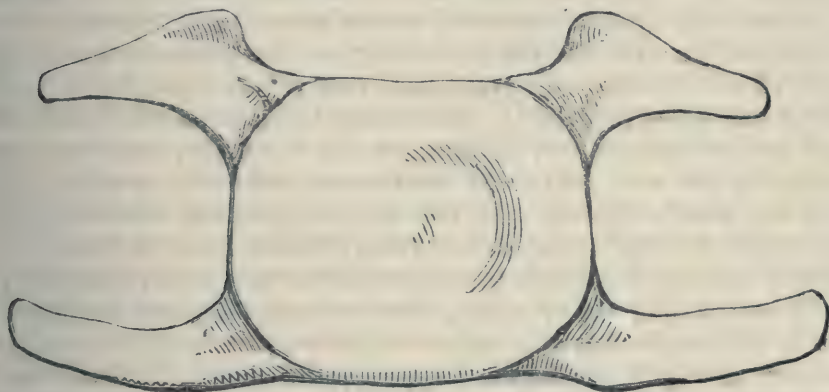
In the study of these animals, I have observed that the form and proportion of the canal of the spinal marrow constitute one of the best characters for the distinction of the Whales. Under these circumstances, I propose to form a genus for this Whale, under the name

ESCHRICHTIUS.

The external form and size of the pectoral fin, and the position and form of the dorsal fin, unknown. Lower jaw with a very low, strongly developed coronoid process. Vertebræ 60. Ribs 15—15. The cervical vertebræ free, the body small, thick, suborbicular, quadrangular, rather wider than high; lateral processes of the third to the seventh vertebræ not forming a ring; the canal of the spinal marrow very broad, compared with the width of the body of the vertebræ, and very high, subtrigonal, with rounded angles. The second cervical not known. Bladebone with a distinct acromion and coracoid process. Arm-bones broad, not longer than the humerus. Fingers, phalanges half as long again as broad. The breastbone

trigonal, rather longer than wide; front part broad, arched out in front, broadly truncated at the sides; the hinder part at first suddenly tapering, for half its length, and then gradually tapering to a point behind.

The body of the cervical vertebra of *E. robustus* from Babbacombe is very thick, and of a nearly uniform thickness; front and hinder surfaces nearly flat; the sides are nearly straight, the lower one being the widest and most arched out. The upper and lower lateral processes are strong; the upper one subtrigonal, slightly bent down, and nearly on a level with the articulating surfaces of the body; the lower one rather compressed above, broader and somewhat flattened on the lower edge. The width of the body $7\frac{1}{2}$, the height 6 inches. The upper processes $3\frac{3}{4}$, and the lower $4\frac{1}{2}$ inches long; but they are evidently broken and sea-worn at the end.



Vertebra of *Eschrichtius robustus*.

This vertebra appears to be either the fourth or fifth cervical, as the lateral processes are nearly on the same plane as the articulating surface; while in the anterior or posterior cervicals they are usually either bent forwards or backwards. It differs from other cervical vertebrae in the squareness of its form, the straightness of the sides, the smallness of the size, and the very great and equal thickness of the body. It is evidently the bone of an adult animal, as the epiphyses are completely united to the body of the vertebra.

The body of the vertebra is nearly as wide and thick as that of the corresponding one in *M. longimana* (width of body 9, height 7, width of neural arch $5\frac{3}{4}$ inches in widest part), at the same time that the space between the bases of the neural arch is nearly $1\frac{1}{2}$ inch wider, and the lateral processes are very much thicker and more developed than in the vertebra of *M. longimana*.

It differs in the same characters, but in a greater degree, from the corresponding cervical vertebra of *Physeter* (width of body 11, height 7, width of neural arch $5\frac{1}{2}$ inches); for in that genus the body of the vertebra is thin and transversely more oblong, and the canal of the neural arch not so broad, compared with the width of the body of the vertebra.

MISCELLANEOUS.

On the Habits of the Southern Sea-Lion.

By Mr. A. D. BARTLETT.

[As I was not able to go to see the Sea-Lion, or Eared Seal, from Patagonia, which I hear has been exhibited in various parts of Europe, and as the account that Mr. Bartlett gave me of its habits was very interesting, and different from that in Buffon and most popular works on natural history, I requested he would put his observations in writing for me.—J. E. GRAY.]

To Dr. J. E. Gray, British Museum.

DEAR SIR,—In compliance with your request, I beg to forward the following notes respecting the Seal now living in Cremorne Gardens.

In size it is larger than a full-grown mastiff dog; the neck very long and thick; the head is rather narrow, but otherwise much like the head of a lioness; the eyes large, very full and prominent (quite unlike our flat-eyed Seals). The animal stands on all fours; the hind feet, which are very long, are under the belly; the front legs resting on the wrist, with the feet turned outwards on each side; these are also very long. In this way he jumps or bounds along, with the body bent up, at a great rate, reminding one of a weasel or polecat. In this manner it progresses as fast as a man could run, or nearly so; it also walks about, slow or fast, following its master, suiting its pace to his with great ease, the great length of its feet, however, giving it an awkward appearance; in fact, the feet have a very slovenly look. It climbs over chairs or other obstacles with facility, and ascended a raised platform upwards of 5 feet high, at the word of command pulling a trigger with its mouth, and firing a cannon.

The animal roars or growls very much like a lioness, but less loud; it exhibits great attachment to its keeper, but appears fierce to strangers; it raised itself perfectly upright against its keeper, and clasped him round the neck with its front paws, placing its mouth against his lips: in this position it appears about 6 feet high. It certainly has more intelligence than any of the Felidæ. The keeper threw his cap across the room; the animal ran immediately, and, at the command of its master, returned with it in his mouth, taking it to him as readily as a well-trained dog.

The colour of this animal is a rich brown; the ears are narrow, and about an inch in length; the nose is naked, like a large dog's, but the nostrils are capable of being closed; the whiskers long and curved downwards; the tail short: the testes are external, and about the size of those of a lion; they are placed low down, near the tail; the hind feet have nearly straight claws; the fore feet have only the rudiments of the claws visible; the teeth are very dark-coloured, and look like the teeth of a very old animal.

Yours faithfully,

A. D. BARTLETT.

On two new Echinides from Eastern Asia.

By Dr. E. VON MARTENS.

Amongst the Echinodermata collected during the Prussian Expedition to the East the two following species possess a peculiar interest, because they belong to genera of which numerous species are known from former geological periods, whilst they are represented at present only by single divergent species, or by none at all, according as the boundaries of the genera are enlarged or narrowed.

1. *Scutella japonica*, n. sp.

Motsingai (i. e. "Kitchen-shell") of the Japanese Encyclopædia.

Rounded pentagonal, above slightly convex, beneath flat. Ambulacral plates similar, nearly (but not completely) closed at the end, occupying two-thirds of the distance from the centre to the margin; the pores of the same pair are wider apart in the middle of the plate than at its central or peripheral extremity; the furrows uniting the pores of each pair are everywhere distinctly marked. From the end of each ambulacral plate two diverging rows of three or four distant single pores run towards the margin. The margin is rounded; *the anal orifice is situated in the margin*, directed a very little upwards. The furrows of the lower surface divide within the first third of the distance from the mouth to the margin into two branches, which diverge at an angle of about 30° , and each of which again forks twice or three times quite close to the margin. Four genital pores, at equal distances from the centre, like the commencement of the ambulacral plates. Upper surface densely granulated; lower surface set with rather larger tubercles, each of which is surrounded by an impressed space. Colour dark violet above and below. Spines short, cylindrical, of a silky lustre; the lower ones longest (up to 2 mill.). In the interior, near the margin, from five to seven uniting walls between the upper and lower walls.

Diameter 67, height 8 millimètres.

Hab. Japan, in the Mississippi Bay within the Gulf of Jedo, upon a shallow sandy bottom near the shore. Many specimens were found.

The figure cited in the Japanese Encyclopædia represents the ambulacral plates and the ventral furrows in a recognizable manner, so that there is no doubt as to what it is meant for, although an important character, namely, the position of the anal orifice, is not represented.

The present species constitutes an intermediate form between the genera *Scutella*, *Scaphechinus*, and *Echinarachnius*; it might be regarded as forming a separate genus with as much right as the two latter; but just this combination of characters counsels us rather to diminish than to increase the number of genera. *Scutella japonica* agrees in the position of the anal orifice with *Echinarachnius* (and *Scaphechinus*) as opposed to *Scutella*, in the ramification of the ventral furrows with *Scutella* and *Scaphechinus* as opposed to *Echinarachnius*, and, lastly, in the circumstance that the ambulacral plates are situated in the same plane with the interambulacral spaces,

with *Scutella* and *Echinarachnius* in opposition to *Scaphechinus*; but a shallow impression in the middle line of the interambulacral spaces forms a slight indication of the difference of level in *Arachnoides*, which *Scaphechinus* resembles in this respect.

The anal orifice in many *Scutellæ*, although situated on the lower surface, is yet quite close to the margin (*e. g.* in the Miocene *S. subrotunda*, Lamk.); and Agassiz, in characterizing this genus, in 1847, in his 'Catalogue raisonné des Echinides,' says, "Anus marginal or inframarginal;" so that we should not be justified in establishing a new genus only because the anus is removed quite into the margin: but it is nevertheless remarkable that our *Scutella* precisely agrees with *Echinarachnius* and *Scaphechinus* (both of which belong to the present period and to the temperate zone) in the position of the anus, in opposition to all the Tertiary *Scutellæ* with which we are acquainted. Consequently, whilst *Echinarachnius*, notwithstanding its simple ventral furrows, is closely allied to the *Scutellæ* through *Scaphechinus* and *Scutella japonica*, the existing tropical genus *Arachnoides*, Ag. (the only species of which, *A. placenta*, Linn., I have collected at Timor), remains further removed from them, not only by the acute margin, the position of the anus above the margin, and the elevation of the ambulacral zones over the interambulacral spaces, but also, as Prof. Beyrich indicated to me, by the remarkable retrogression of the interambulacral plates upon the lower surface, inasmuch as these (leaving out of consideration the innermost circle, nearest to the mouth) occur only at the margin, and of small and unequal size. The short description of *Scaphechinus mirabilis*, A. Agass. (Proc. Acad. Nat. Sci. Philad. 1863, p. 359), contains nothing contradictory to our species, except the comparison with *Arachnoides* with regard to the difference of level between the ambulacral and interambulacral spaces: I am therefore inclined to regard that species as most nearly allied to mine; and *Scaphechinus* (as also *Echinarachnius*) as a subgenus of *Scutella*, the characters of which, occurring more prominently in the only species hitherto known, pass through *Scutella japonica* into those of the genus *Scutella*.

2. *Nucleolites epigonus*, n. sp.

Shell flat, oval, covered with uniform (spinigerous) tubercles, each of which is surrounded by an impressed space. Lower surface slightly concave; buccal orifice near its middle (at $\frac{6}{11}$ ths of the length), elongate-oval, its margin turned inwards, smooth; no trace of an ambulacral star round it, except that the direction in which the ambulacral zones run may be detected in the arrangement of the tubercles and in scarcely perceptible depressions of the surface. Anal orifice elongate-oval, situated in the inflated posterior side of the Urchin, nearly vertical, only a little inclined upward, above the margin, but not extending upon the dorsal surface; a short, broad, channel-like excavation passes from it to the inferior margin. Ambulacral plates uniformly narrow, not closed, reaching half the distance between the vertex and the periphery, the two posterior ones a little longer; in these also it may be more distinctly seen than in

the others that they are each continued as two whitish streaks, but without pores, to the periphery, and beyond this towards the mouth. The pores of the same pair are united by very shallow furrows, which can be seen distinctly only in particular spots. Ambulacral plates at the same level as the interambulacral spaces; the posterior interambulacral space presents in its median line a very faint ridge-like edge, running from the vertex to the upper margin of the anal orifice.

Length 17, breadth $13\frac{2}{3}$, height 8, longitudinal diameter of mouth 2 millimètres.

Hab. The island of Adenare, at the eastern end of Flores (between Java and Timor). One specimen found, thrown up on the beach.

The only species of this genus previously known (*Nucleolites recens*, M.-Edw., from Australia) is distinguished essentially by a deep furrow in the posterior interambulacral space in which the anal orifice is situated, as also by its broader form, from our species, in which the short channel beneath the anus is the only indication of the above-mentioned furrow. We know, however, numerous species, from the Jurassic, Cretaceous, and Tertiary periods, with and without furrows uniting the ambulacral pores: most of them have the anal orifice placed higher up; but even in this respect the well-known *N. neocomensis*, Ag., agrees with our species, as indicated by the specimens in the Palæontological Collection here. The statement, "anal orifice superior," or "on the dorsal surface," which is to be found in most books among the characters of this genus, may therefore be expressed more accurately as follows:—"Anal orifice above the periphery." Desor, in his most recent elaboration of the Echinides (Synopsis des Echinides fossiles, 1858), divides the genus *Nucleolites* into two, according as the ambulacral pores of each pair are united by a furrow (*Nucleolites*) or not (*Echinobrissus*). The shallow, hardly perceptible furrows of the present species do not justify any such division.

I may take this opportunity of remarking that a younger specimen of *Oreaster armatus*, Gray, described by me in the 'Monatsbericht' for January 1865, p. 156 (see Annals, p. 433) has been described and figured by Möbius, under the name of *Goniodiscus conifer*, in the 'Abhandlungen der naturwissenschaftlichen Gesellschaft zu Hamburg,' Band iv. The difference in the determination of the genus is explained by the fact that (as Lütken has already stated, and as I find to be the case in the Indian species, of which I have series of different ages) in young specimens of *Oreaster* both the inferior and superior marginal plates assist in forming the margin—a character which is permanent in *Goniodiscus* and *Astropecten*, but undergoes a change with growth in *Oreaster*.—*Monatsber. Akad. Wiss. zu Berlin*, March 1865, p. 140.

A New American Silkworm.

After numerous experiments, Mr. L. Trouvelot, of Medford, Mass., has succeeded in rearing, and in great numbers, *Attacus Polyphemus*, Linn., and in preparing from its cocoon an excellent quality of silk,

possessing great lustre and strength, and pronounced superior to Japanese and all other silks, except the best Chinese, by competent judges.

The silk is unwound by a simple process perfected by Mr. Trouvelot, each cocoon yielding about 1500 yards. This insect is very hardy, being found throughout the Northern States and Canada, and, as it feeds upon the leaves of oak, maple, willow, and other common forest trees, may be reared easily in any part of the country.

Mr. Trouvelot has gradually increased his stock from year to year, by raising young from the eggs of the few individuals first captured, until he has at present seven waggon-loads of cocoons, the entire progeny of which he proposes to raise during the coming season.

The thanks of the country are due to the ingenious and persevering author of this successful attempt to introduce a new and interesting field for industry and enterprise, which cannot fail to be a source of profit to those who intelligently engage in it, and of increased wealth and prosperity to the people, should it be developed to the extent that now seems possible.

The first public notice of his experiments with this insect was given by Mr. Trouvelot at a meeting of the Institute of Technology, at Boston, about a year ago, when he exhibited specimens of silk manufactured from it, both natural-coloured and dyed.—*Silliman's Journal*, March 1865.

On Viviparous Fishes of the Genus Hemirhamphus.
By Professor PETERS.

Whilst most of the Sharks and Rays, with the exception only of the oviparous *Scyllia* and *Rajæ*, produce living young, the other Fishes are usually oviparous. Exceptions to this rule are comparatively rare: according to extant observations, there are only, among the Cataphracti, *Sebastes viviparus*, Kröyer (as observed by Kröyer); among the Blennii, *Zoarces viviparus*, Linn.; among the Cyprinodontes, the genera *Anableps* and *Pæcilia* (and *Mollienisia*); and the whole of the Embiotocæ. Dr. Jagor, however, has made the interesting observation that certain species of the genus *Hemirhamphus* are likewise viviparous—a genus which belongs to the family of *Scomberesoces*, in the eggs of which Dr. Haeckel (Müller's Archiv, 1855, p. 23) has discovered a remarkable production of peculiar fibres between the yolk and the vitelline membrane. The species in which Dr. Jagor has discovered this mode of development are—

1. *Hemirhamphus fluviatilis*, Blkr. (*Dermogenys pusilla*, K. v. H.). “Sept. 1858, Java, island of Nusa Kumbangu, from a limestone cavity of the Beck Manundjaja; fish with embryos.”

2. *Hemirhamphus viviparus*, n. sp. Pinna caudali convexa; pinna dorsali anali brevior, radio primo post radium primum analem inserto; pinnis analibus post $\frac{9}{16}$ longitudinis totalis insertis; capite dorsoque subplanis; longitudine capitis $\frac{5}{16}$ longit. totalis æquali; flavescens, nigro irroratus, rostri apice, lineis tribus a nucha ad pinnam dorsalem extensis, membrana inter radium primum et secundum

analem, radii secundi et tertii dorsalis parte basali maculaque post-operculari nigris. Squamis lin. long. 45, transv. 12 vel 13. D. 10 vel 11; A. 14 vel 15. Longitudo tota 0·095 metri.

In the whole structure of the body this species is very similar to the preceding one, but it is considerably larger. The two species might probably be distinguished, by the rounded, and not bilobed, caudal fin, and the short dorsal fin, as a peculiar and readily recognizable subgenus, from the rest of the *Hemirhamphi*; for this the name *Dermatogenys* (*Dermogenys*), proposed by Kuhl and Van Hasselt, might then be retained.

Dr. Jagor took this last species upon the island of Samar, in the Basey River, "with living young and fully developed ova," as stated in the note appended to it, and as shown by the specimens.—*Monatsber. Akad. Wiss. zu Berlin*, March 1865, p. 132.

On the Production of the Sexes.

By M. COSTE.

In a former Number of the 'Annals' (ser. 3. vol. xiii. p. 68) a translation was given of a remarkable paper by M. Thury, of Geneva, upon a supposed law of the production of the sexes in cattle. M. Thury believes that the ovum changes its sex as it becomes more and more mature, being female at the commencement of the rutting-period, and male towards its conclusion: hence, by permitting animals to copulate only at the commencement or close of the rut, female or male offspring ought to be procured. This, M. Thury says, has been done in twenty-nine experiments made for the confirmation of his hypothesis; but M. Coste, whilst admitting the value of Thury's observations, as probably calling attention to the direction in which researches on this most interesting but difficult subject should be pursued, states that his own researches have led him to conclusions opposed to those of the Swiss physiologist.

M. Coste denies that the descent of the ovum takes place at the commencement of the rut, and that it is impregnated during this descent, as assumed by M. Thury. He says that during this period the ovum remains enclosed in its capsule, and that the rut ceases with the descent of the ovum into the matrix. When this takes place without fecundation, the ovum is abortive; and the fecundation takes place within the ovary, and whilst the ovum is still enclosed in its capsule. When female animals are opened two hours after copulation, the spermatozooids are found moving among the fringes of the vestibule and upon the surface of the ovary itself. Hence the question is, whether the two degrees of maturation assumed by M. Thury exist during the ovarian life of the ovum.

Now the most mature ovum must be that of which the dehiscence is imminent or has just taken place, and of which the germ, if not at once impregnated, would perish immediately. According to Thury, such an ovum should give a male product; one which has not attained to this limit of evolution should furnish a female product. To test this hypothesis, birds (in which a single copulation

impregnates a whole series of ova arranged in the ovary in the order of their maturation, from the egg which has burst its capsule to those which have to undergo a fortnight or three weeks of ovarian evolution before dehiscence) present a ready field for experiment. In these the various degrees are so clearly marked that there is no room for confusion. If the theory is well founded, the first eggs of each series should furnish males, and the last females.

In M. Coste's experiments this result has not been attained. Of five eggs laid after a single copulation, the first two gave males, the third a female, the fourth a male, and the fifth a female. The experiments were continued by M. Gerbe. A hen, after impregnation, laid fourteen, and, after a second impregnation, eleven eggs, of which the order of laying was noted. Of the first series, the second, seventh, eighth, and tenth eggs gave male birds; the fifth, ninth, and eleventh female, and the remainder were infertile or abortive. Of the second series, the second, third, sixth, and seventh furnished females; the fourth and eighth males; the first and the last three were infertile, and the fifth was broken during incubation. Thus it appears that, in the fowl, males and females are produced indifferently, and not in an order corresponding with the maturity of the eggs, and that M. Thury's theory does not apply to these birds.

If it be held that the impregnation does not take place while the ovum is still retained within its capsule, but that the spermatozooids lie in wait upon the surface of the organs, to impregnate the ova during their passage towards the oviduct (after the analogy of Insects), it must still be admitted that every impregnated ovum must have attained its extreme limit of maturation.

But in the Mammalia a phenomenon occurs which has no parallel in birds: copulation precipitates the dehiscence of the capsule of the ovum; so that ova may be at pleasure made to separate from the ovary two or three days sooner or later, according as the females are allowed access to the males at the commencement or towards the end of the rut. In the former case, the products should be female; in the latter, male.

To test this view, M. Gerbe has made some experiments on rabbits. A female rabbit in which the rut was but just commencing, so that she resisted the approaches of the male for several hours, was isolated after copulation, and killed in four weeks. The right horn of the uterus contained three, and the left one nine young, of which the sexual relations were as follows:—

In the right horn: the first, *female*; the second, *MALE*; and the third, *female*.

In the left horn: the first, *MALE*; the second and third, *female*; the fourth, fifth, and sixth, *MALE*; the seventh, *female*; and the eighth and ninth, *MALE*.

A second rabbit, far advanced in heat, was killed four weeks after copulation. The right horn of the uterus contained five, and the left seven young. These were—

In the right horn: the first, *female*; the second, *MALE*; the third, *female*; the fourth, *MALE*; and the fifth, *female*.

In the left horn: the first, *female*; the second, third, and fourth, *MALE*; and the fifth, sixth, and seventh, *female*.

A third female rabbit, kept from the male until the rut was at its extreme height, in order that the ova might reach their greatest degree of maturity, had three young on the right, and four on the left side. These were—

In the right horn: the first, *MALE*; the second, *female*; and the third, *MALE*.

In the left horn: the first and second, *MALE*; the third, *female*; and the fourth, *MALE*.

It is evident that these observations upon a multiparous mammal do not bear out Thury's law, especially as there are more males than females, even in the first case, when copulation took place at the commencement of the rut. Nevertheless the preponderance of males (5 : 2) in the last instance is remarkable.—*Comptes Rendus*, May 8, 1865, p. 941.

On a new Species of Basse (Labrax Schönleinii) from Celebes.
By Professor PETERS.

In a collection of fishes from Celebes received by the Zoological Museum at Berlin from the bequest of the late Dr. Schönlein in 1840, there is a species of *Labrax*, a genus which, as now constituted, has been regarded as limited to European seas. In his notices of the fauna of Celebes and of the Indian seas generally, Bleeker mentions no species of *Labrax*. Hence this fish might be regarded as not really coming from Celebes, but for its being referred to in Schönlein's original catalogue of fishes from Celebes as "no. 12. *Labrax punctatus*, n. sp.," along with only 112 other species, all of which are well known to occur in the seas of that part of the world.

This species agrees most nearly in its dentition and colouring with that which Dr. Günther (Ann. & Mag. Nat. Hist. Sept. 1863) has lately distinguished from the other two Mediterranean species under the name of *Labrax punctatus*, regarding it as *Sciæna punctata*, Bloch. The present species has the same number of fin-rays as the one just mentioned, namely, D. 9 – 1, 13; A. 3, 12; lateral line with 58 to 60 scales, above it 9, and below it (to the anal fin) 11 rows of scales; it differs greatly from Bloch's figure (pl. 305) by its much narrower præoperculum, between the posterior margin of which and the eye there are only three rows of scales.

In *Labrax diacanthus* and *L. punctatus* the distance of the margin of the præoperculum from the eye is equal to the diameter of the latter; in the present species it is only one-half of it. In this respect it is more like *L. orientalis*, Gthr., from the Egyptian coast.

Professor Peters agrees with Dr. Steindachner in thinking that *L. elongatus* (genus *Dicentrarchus*, Gill) is to be united with *L. diacanthus*, Bloch (*Lupus*, Lacép.). Ehrenberg's specimens from Alexandria, referred to this species by Valenciennes, all have three anal spines, whilst two other examples of *L. diacanthus*, from Cetta and Trieste, present *abnormally* only two spinous rays in the anal fin.—*Monatsber. Berl. Akad. der Wiss.*, February 1865, p. 95.

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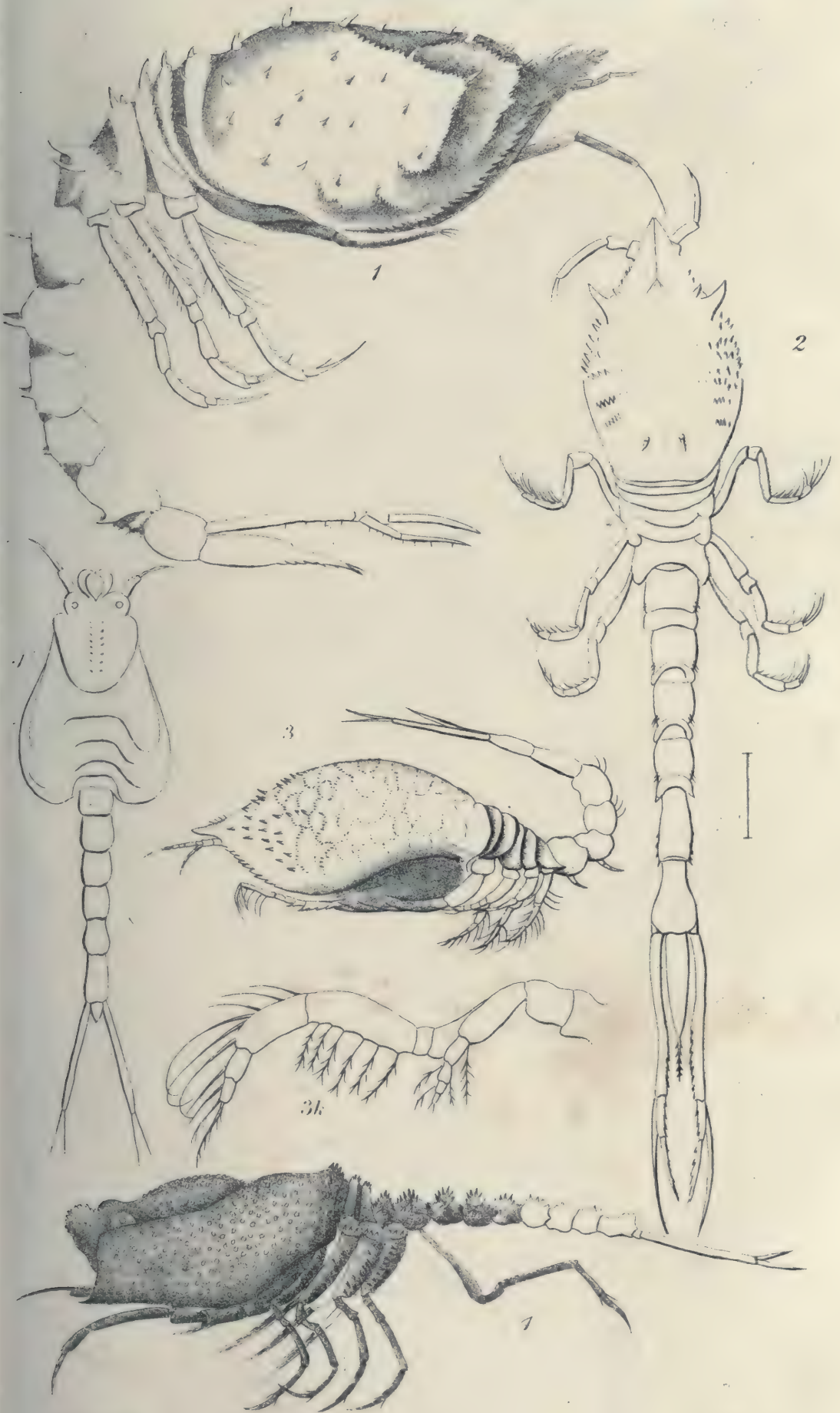
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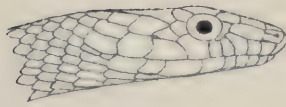
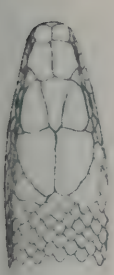
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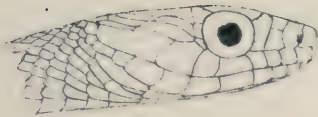
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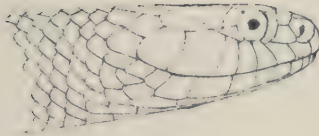




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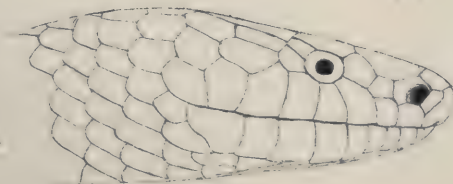
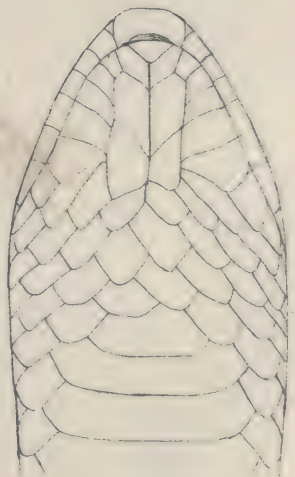
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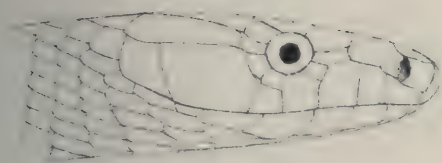


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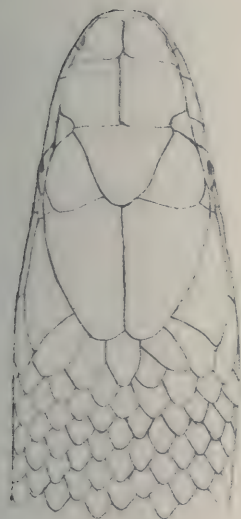
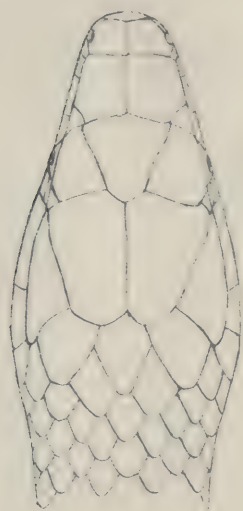


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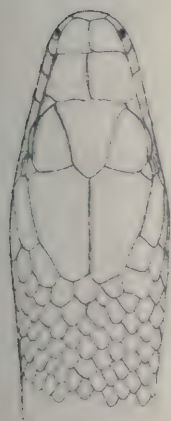
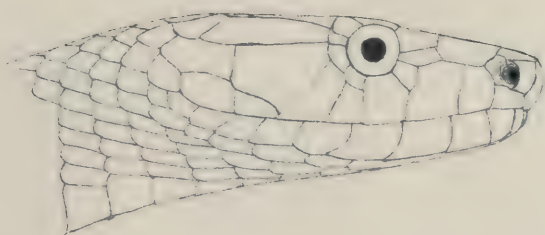




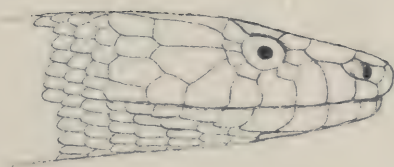
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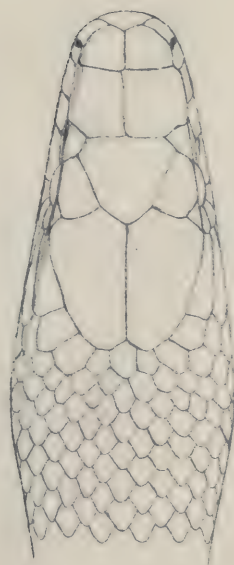
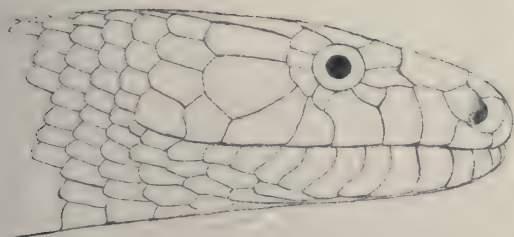
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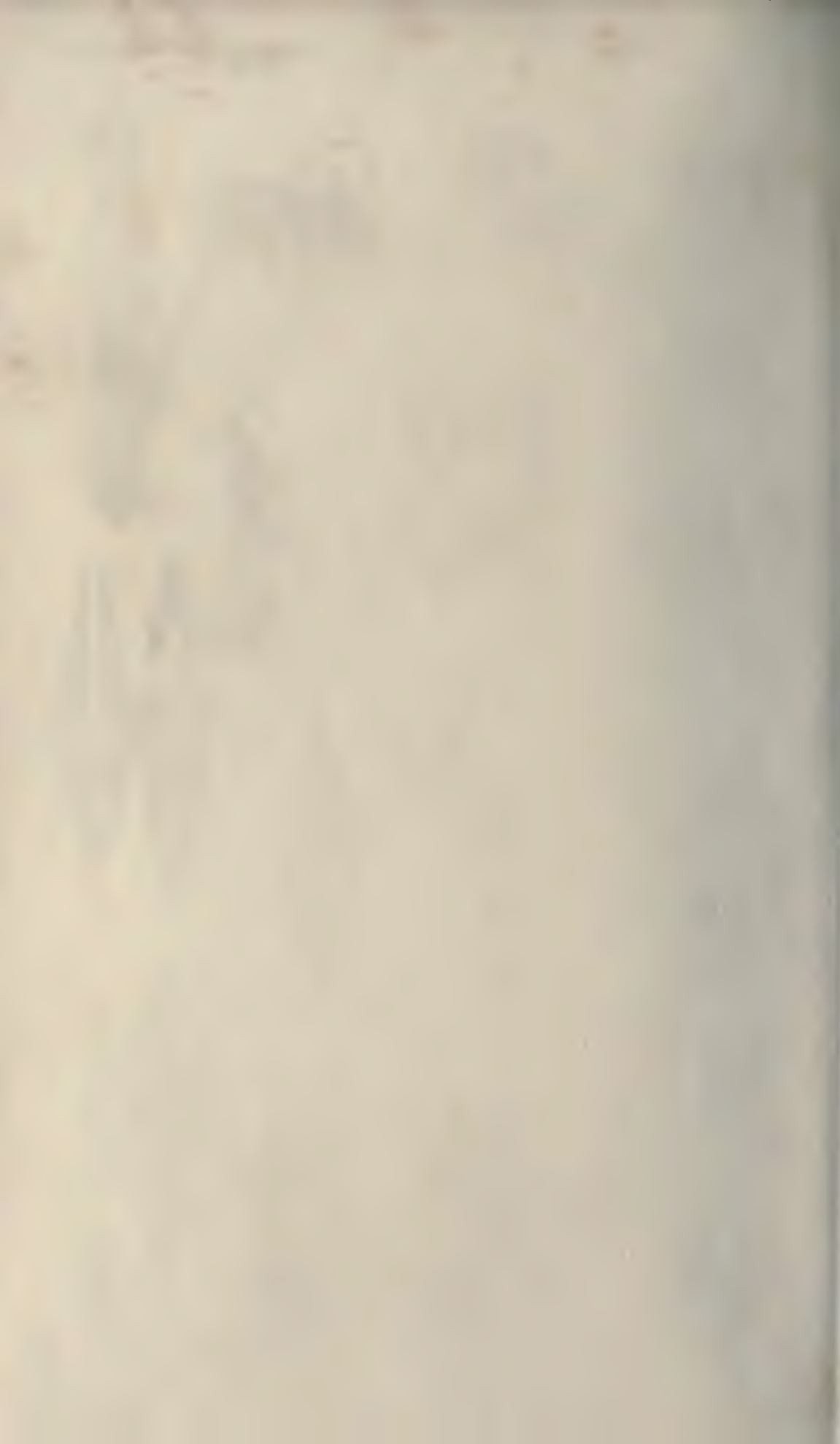


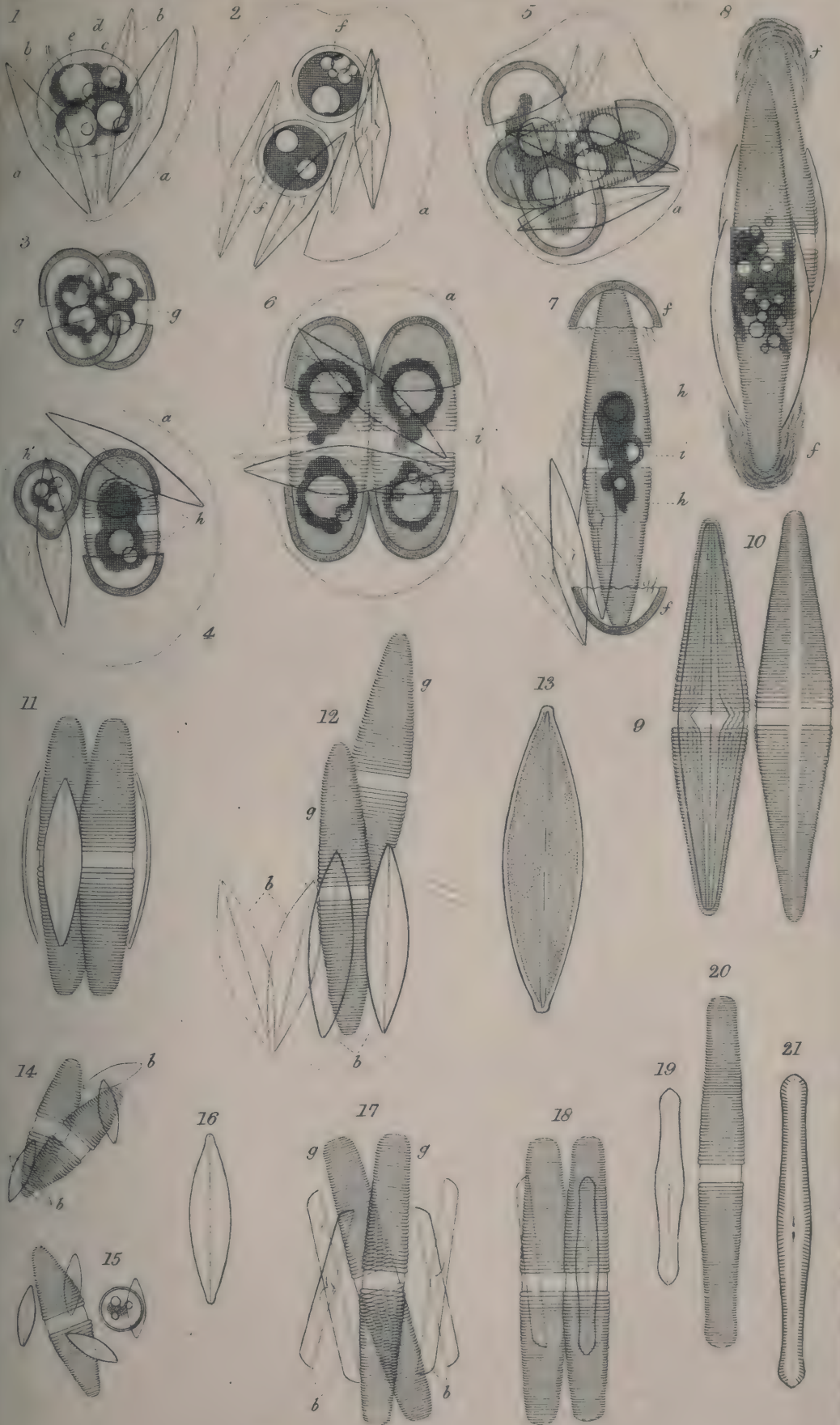
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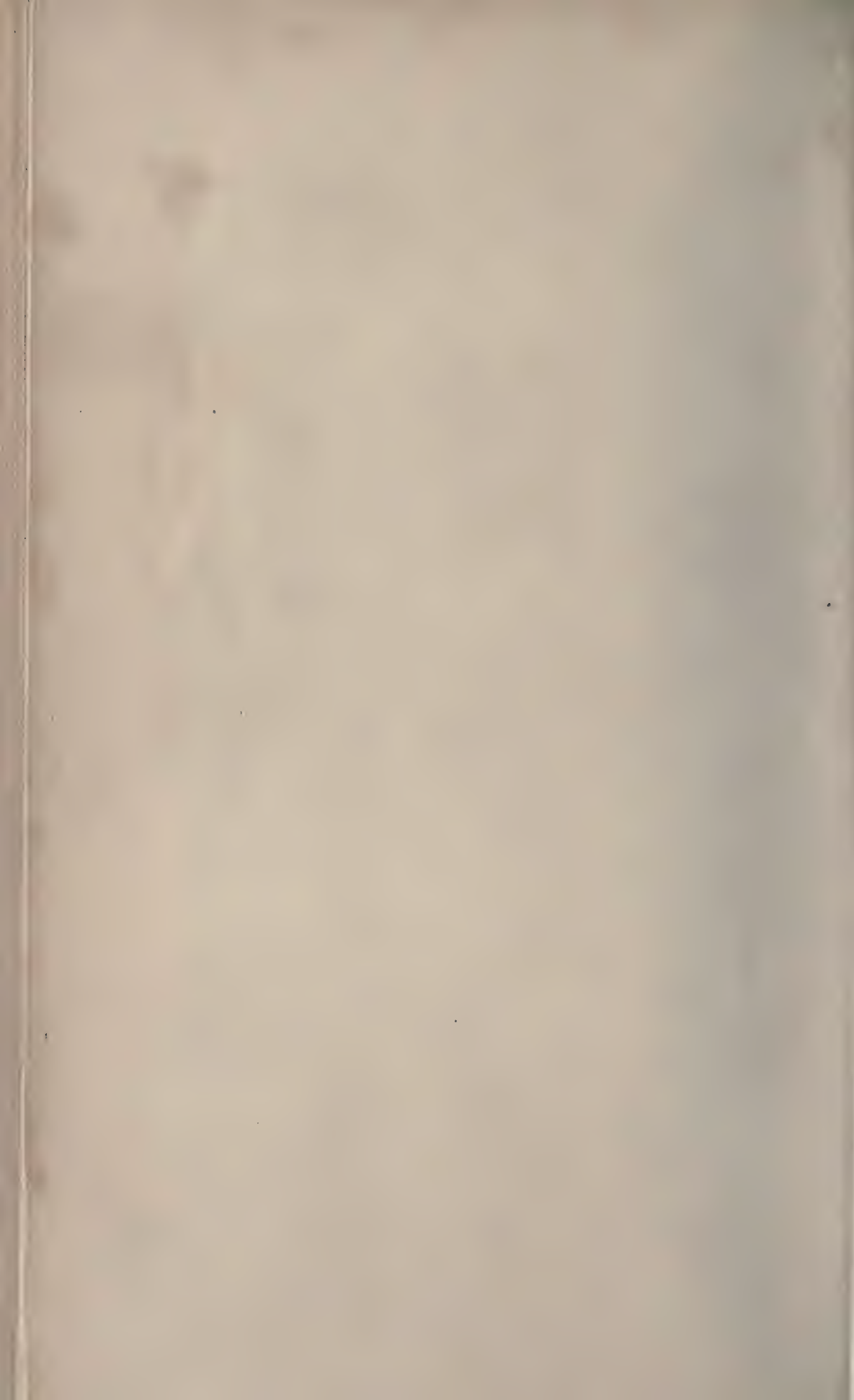


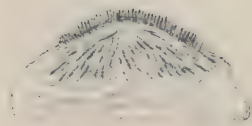
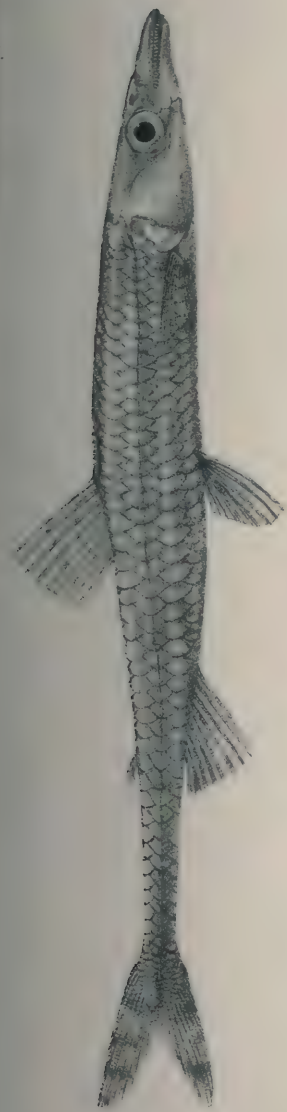
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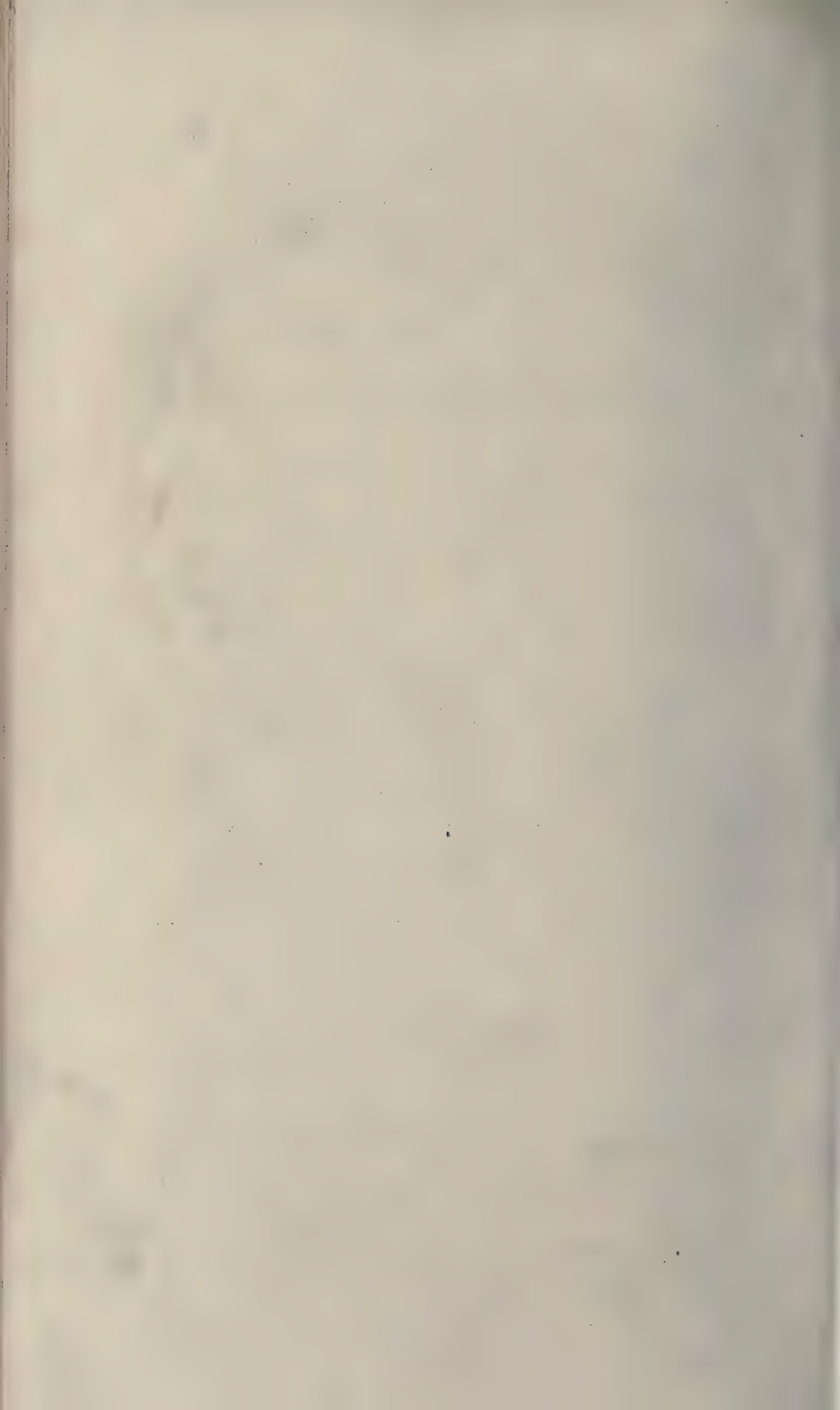


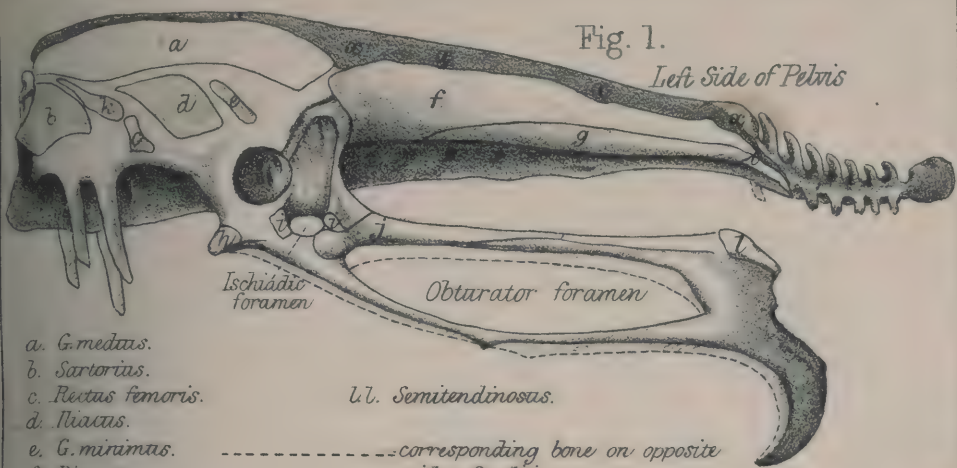






Phago loricatus.



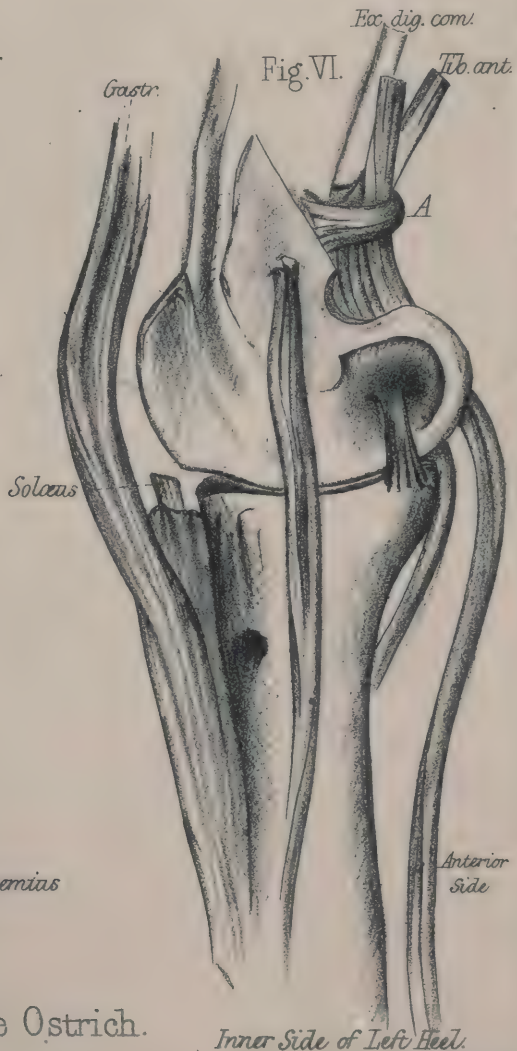
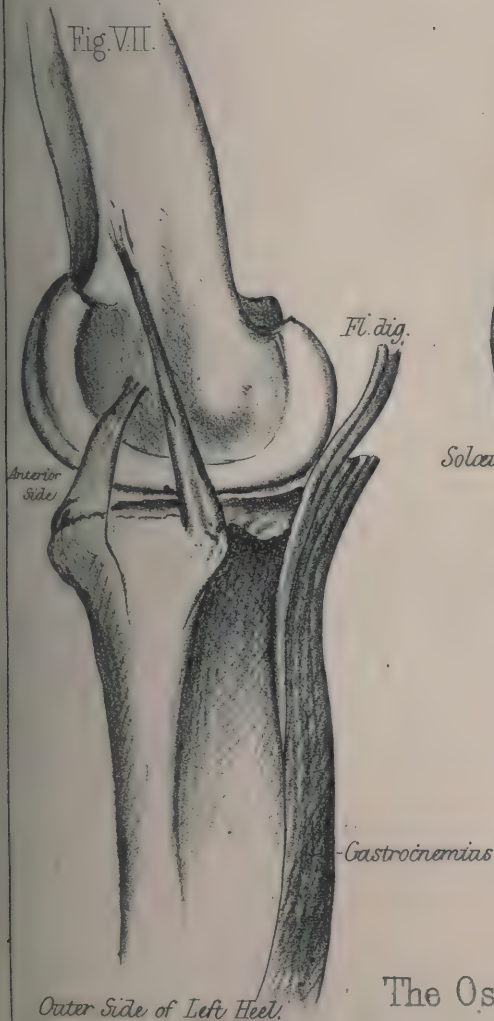


- a. *G. medius.*
- b. *Sartorius.*
- c. *Rectus femoris.*
- d. *Iliacus.*
- e. *G. minimus.*
- f. *Biceps*
- g. *Semimembranosus.*
- h. *Pectineus.*
- i. *Gemelli*
- j. *Adductor magnus.*
- k. *Opponens quadrato femoris.*

l. l. *Semitendinosus.*

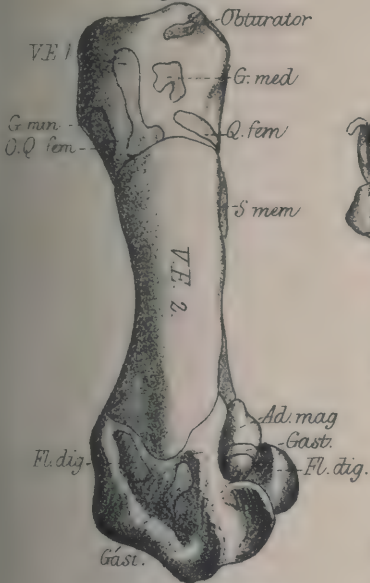
----- corresponding bone on opposite side of pelvis.

α. α. Triple muscle, consisting of *Tensor vagina femoris.*
Gluteus maximus, and *Agitator caudæ.*



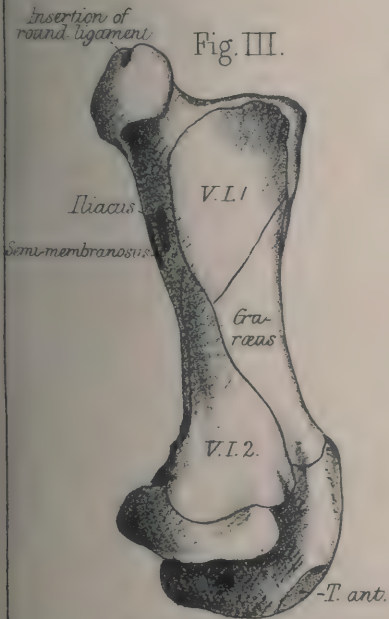
The Ostrich.

Fig. II.



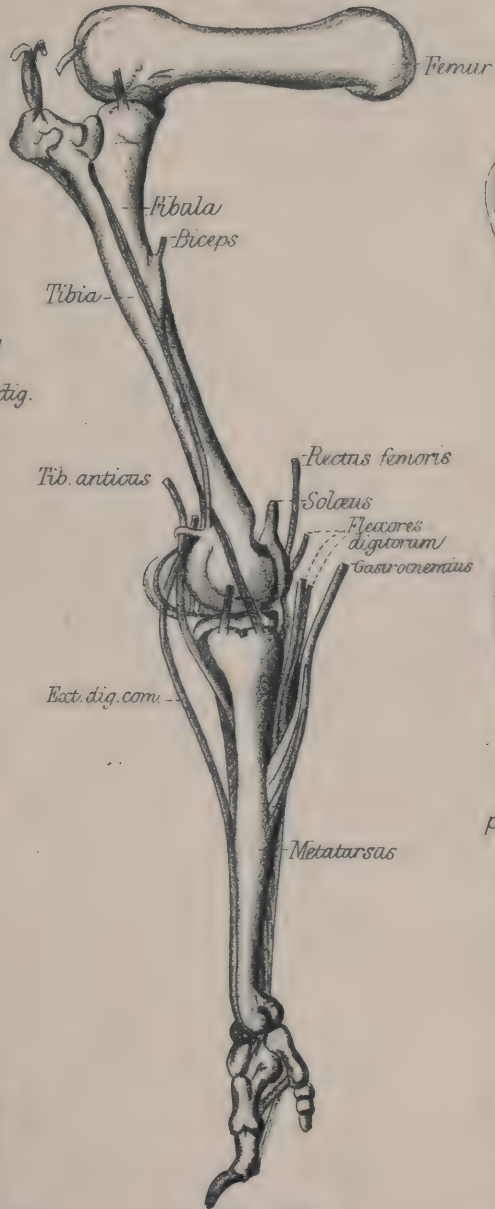
Outside of left femur.

Fig. III.



Inside of left femur.

Fig. V.



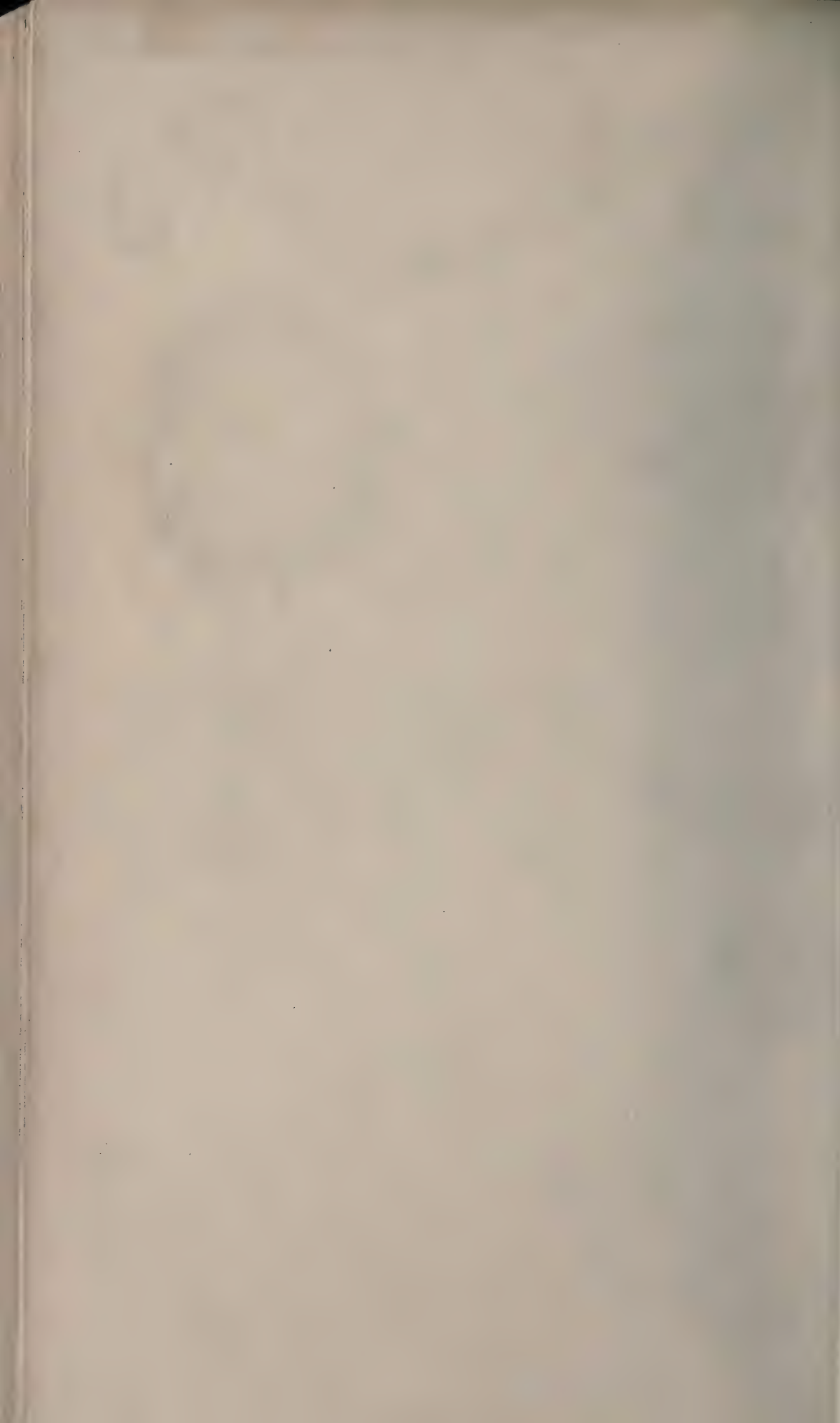
Left thigh,
leg & foot.

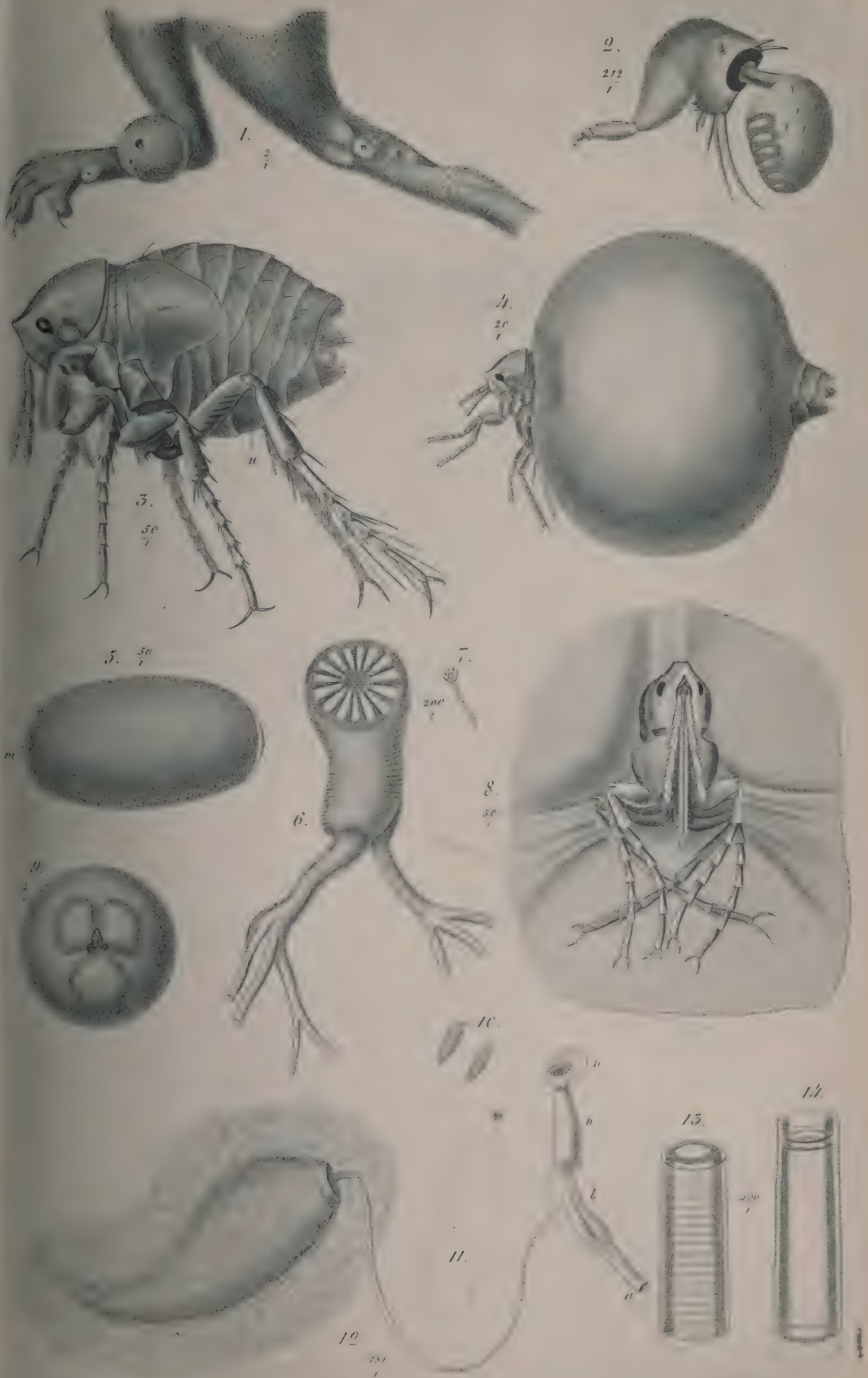


Rectus
femoris

Fig. IV.

The Ostrich.





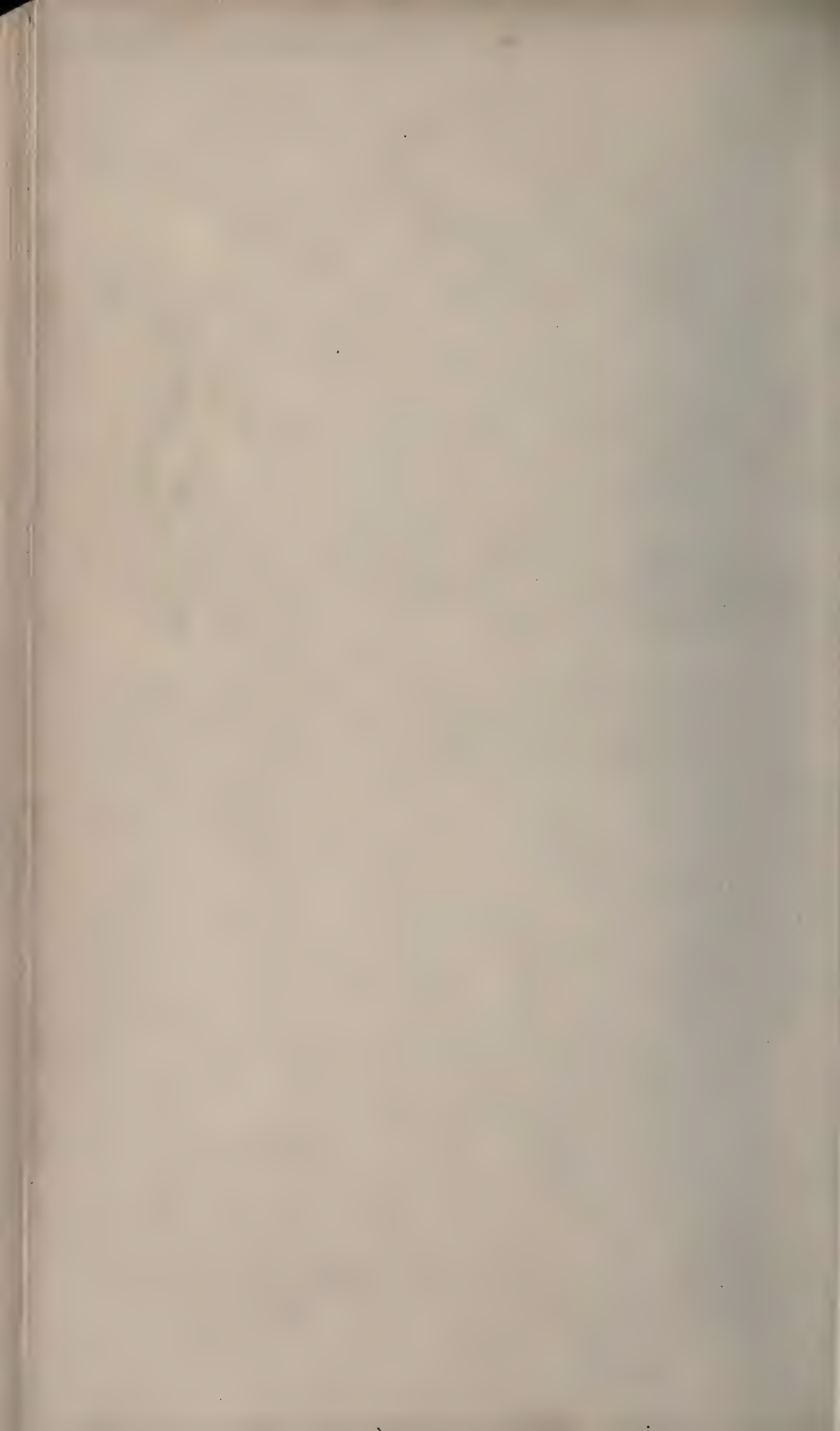
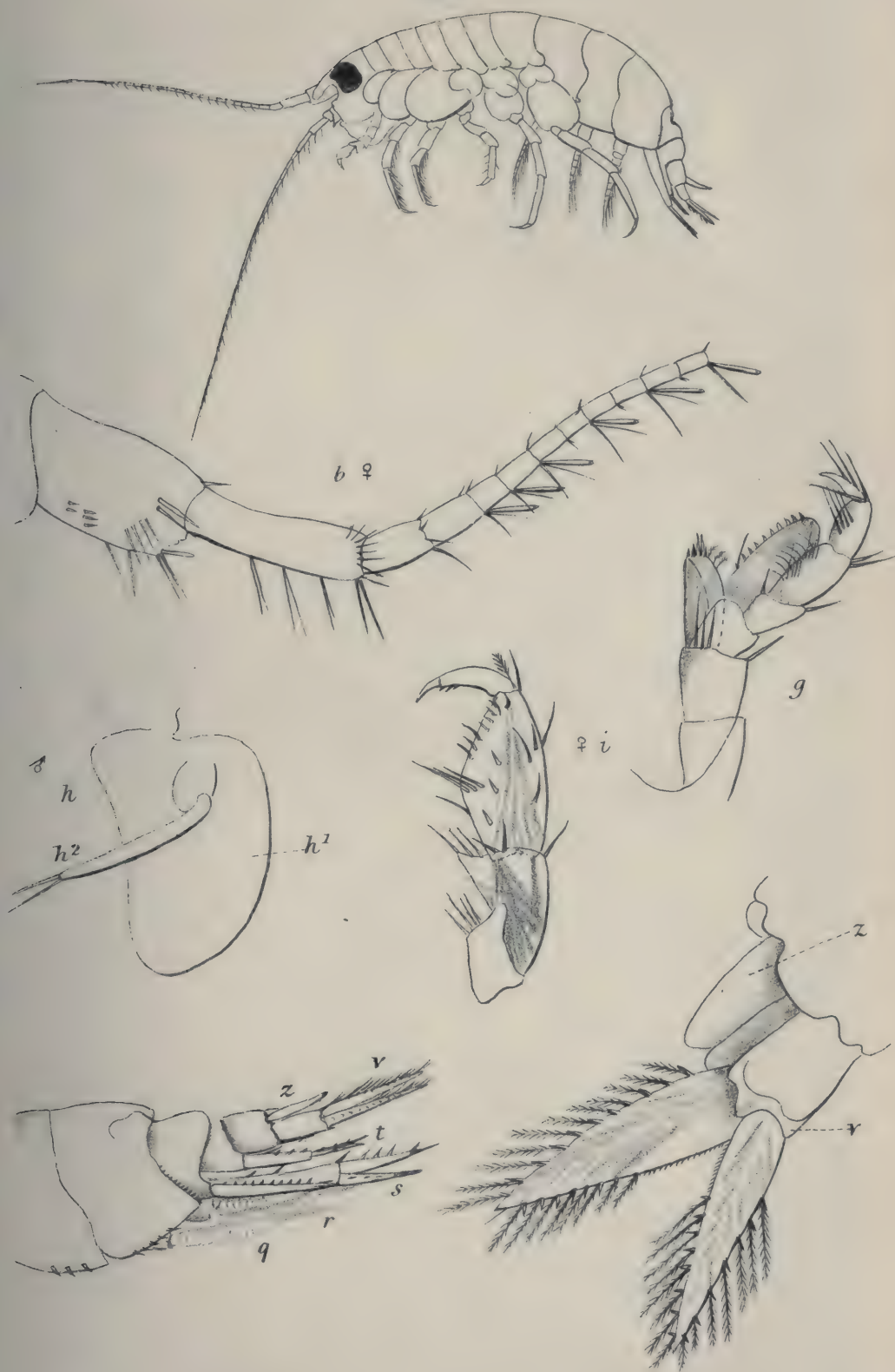
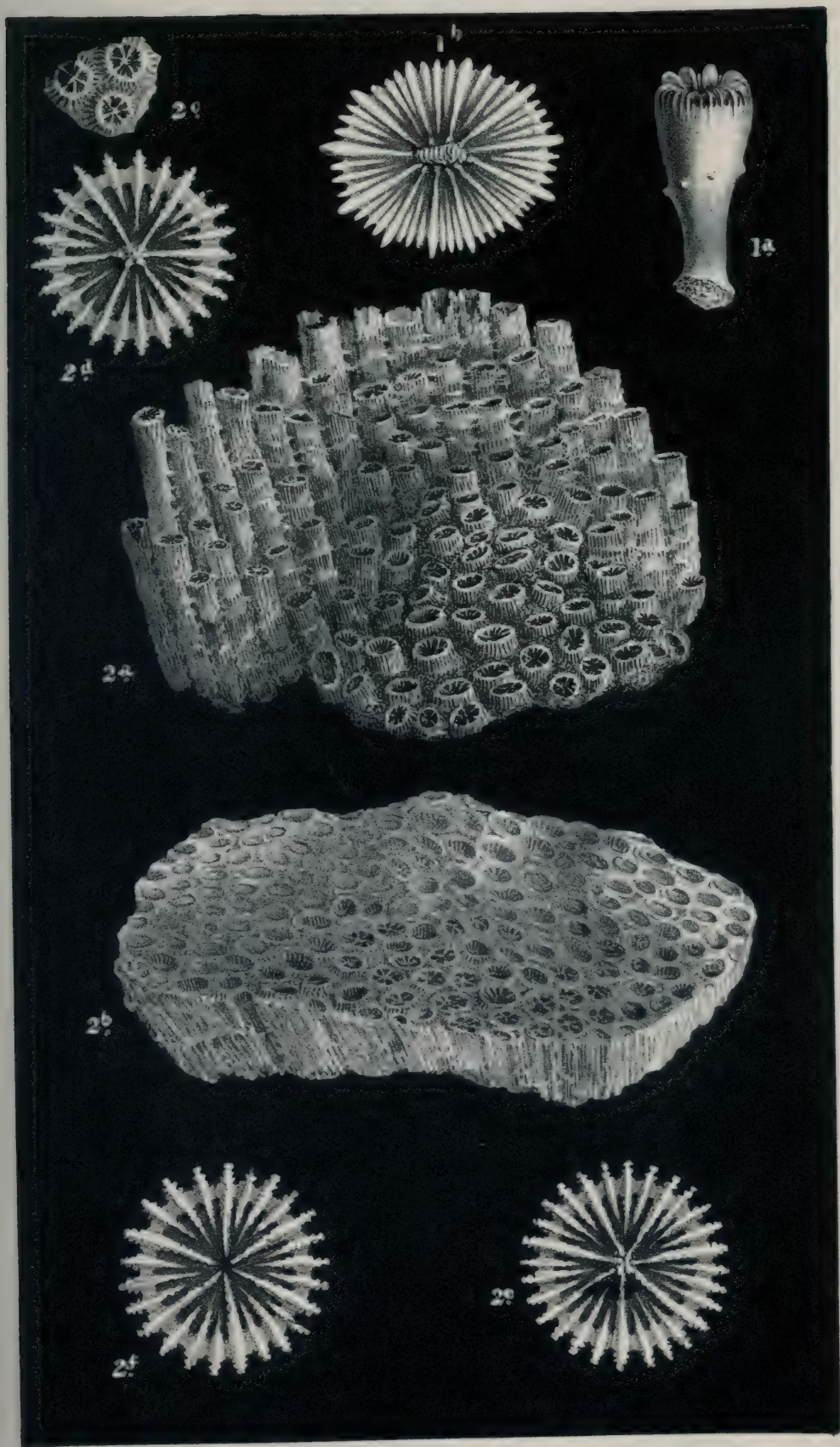
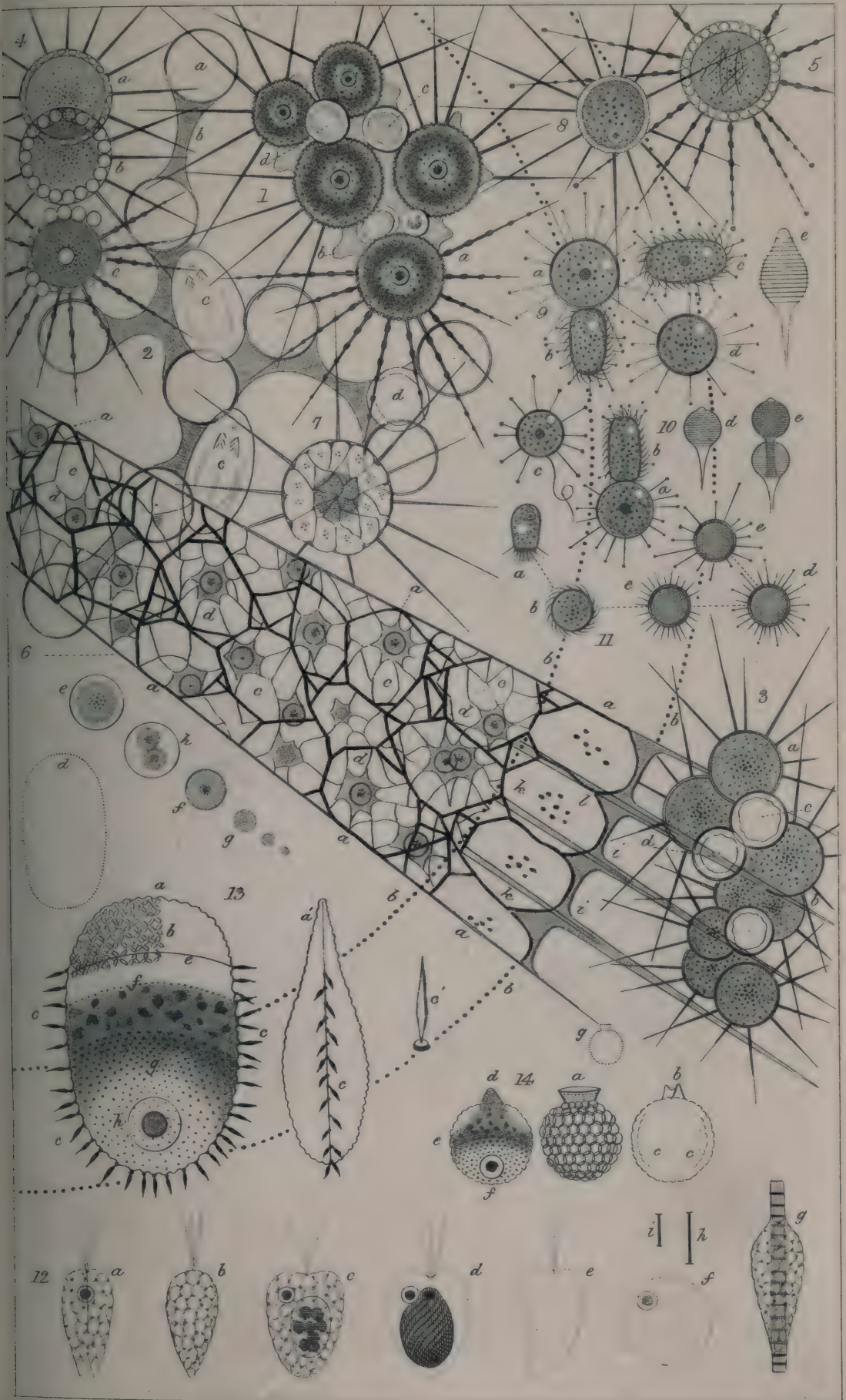




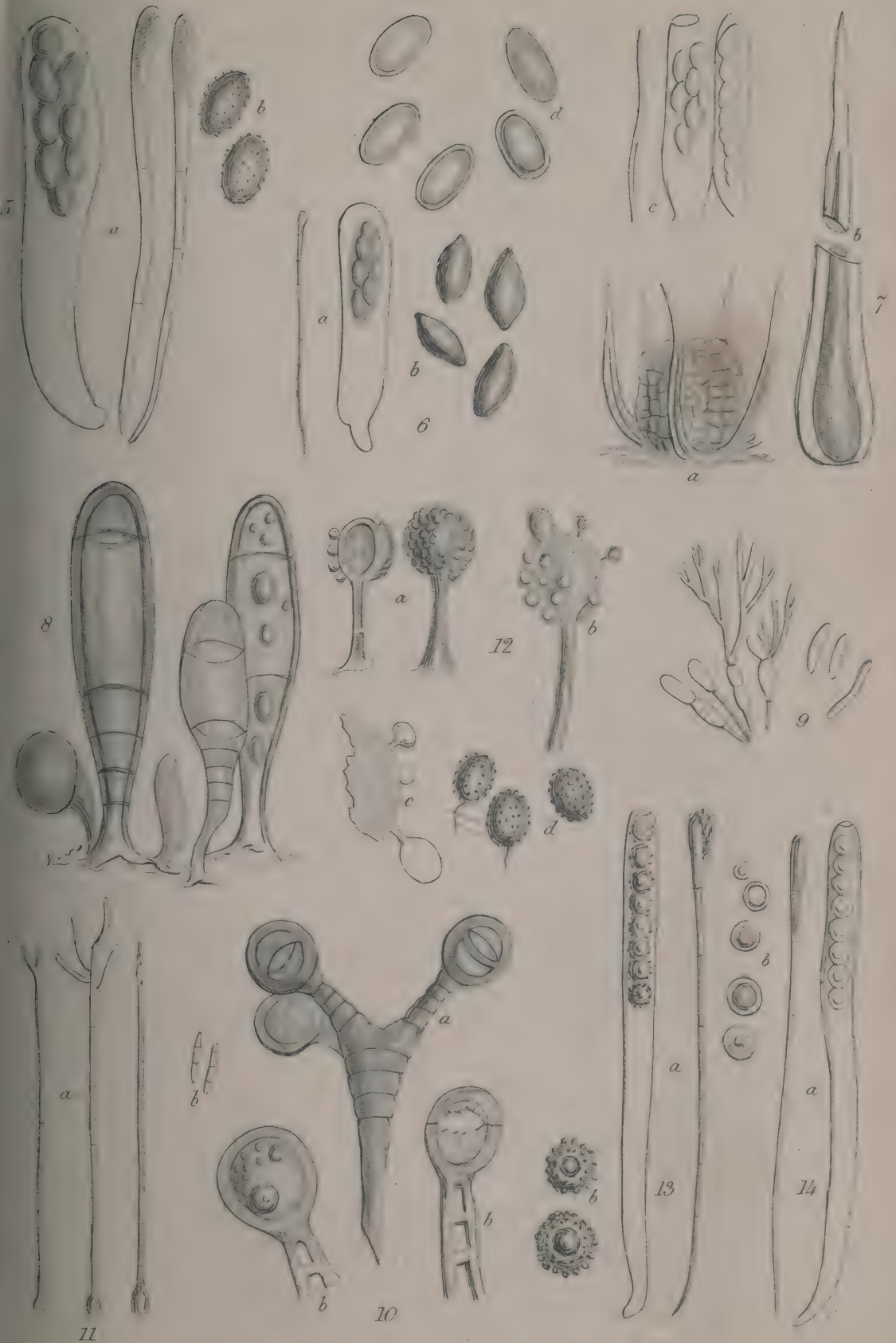
Fig. 1. ♂

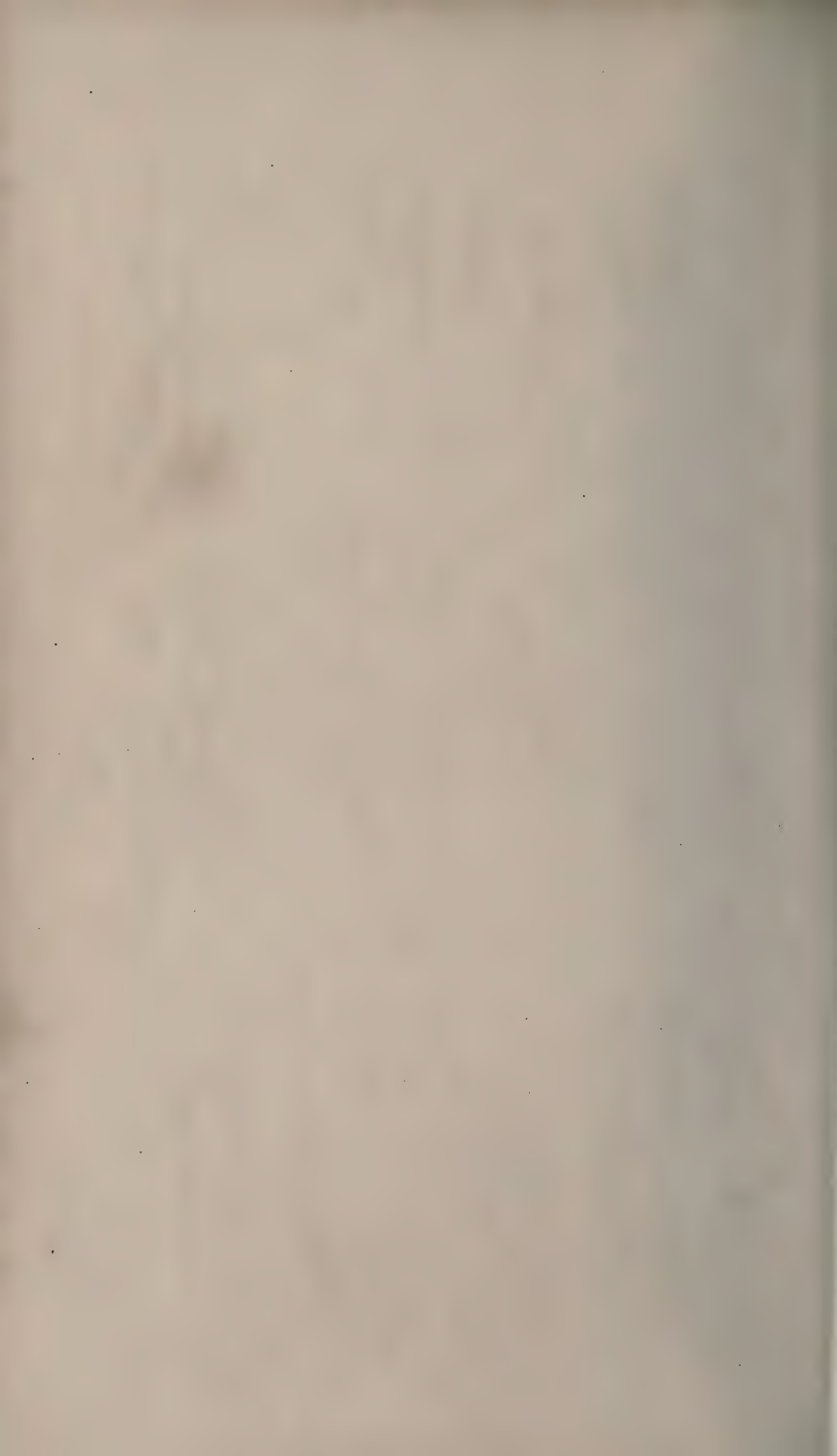


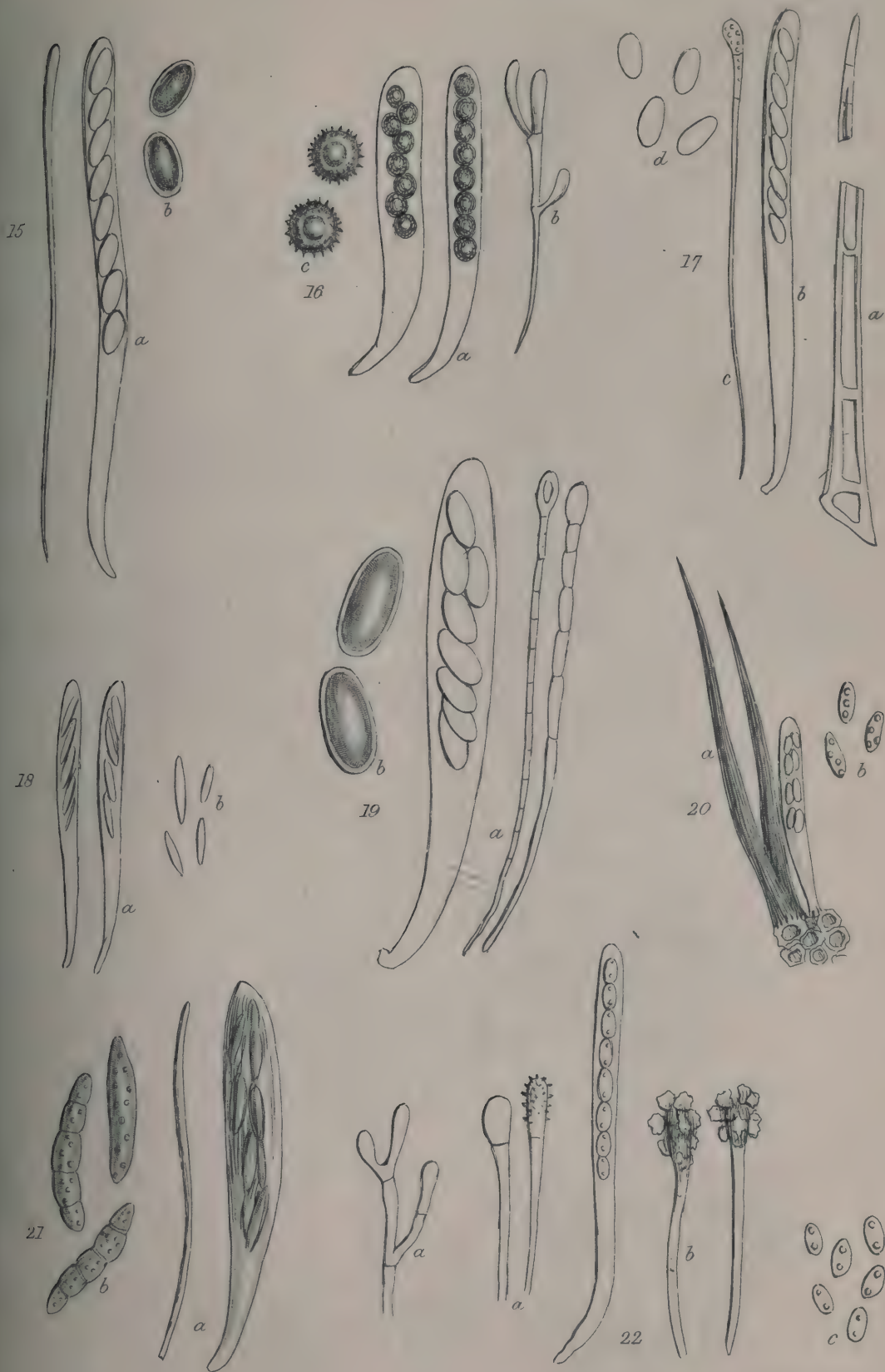


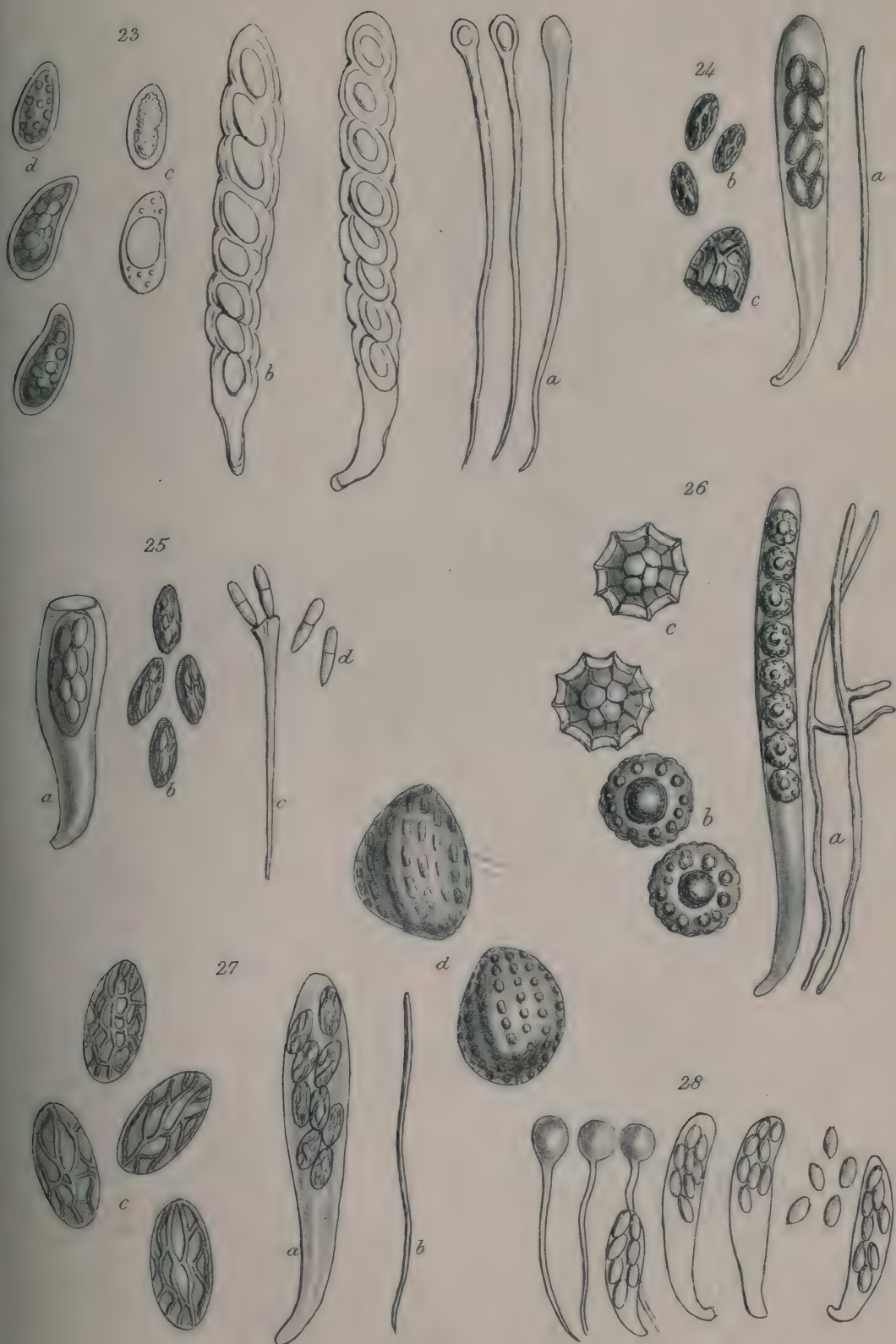


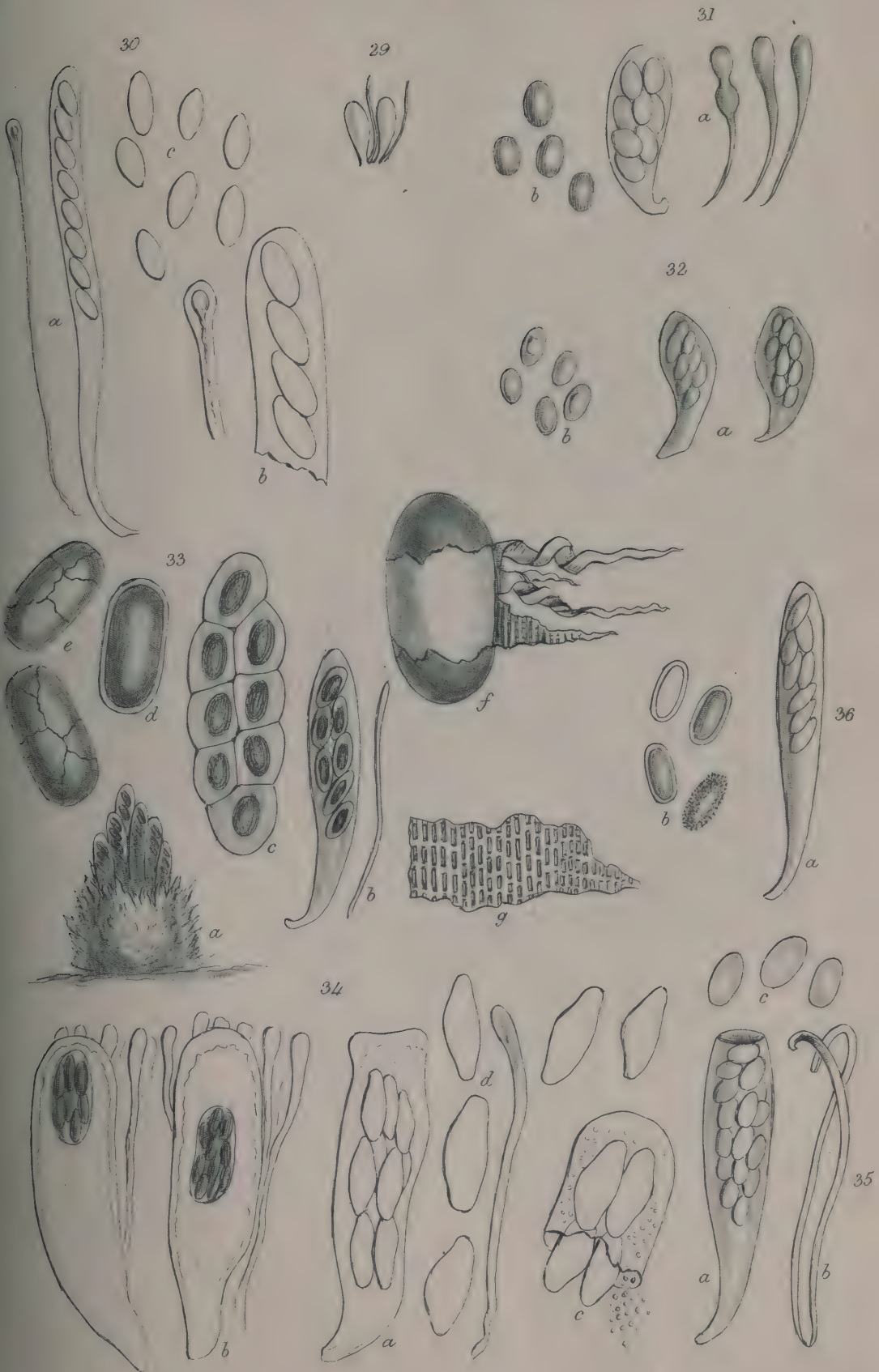












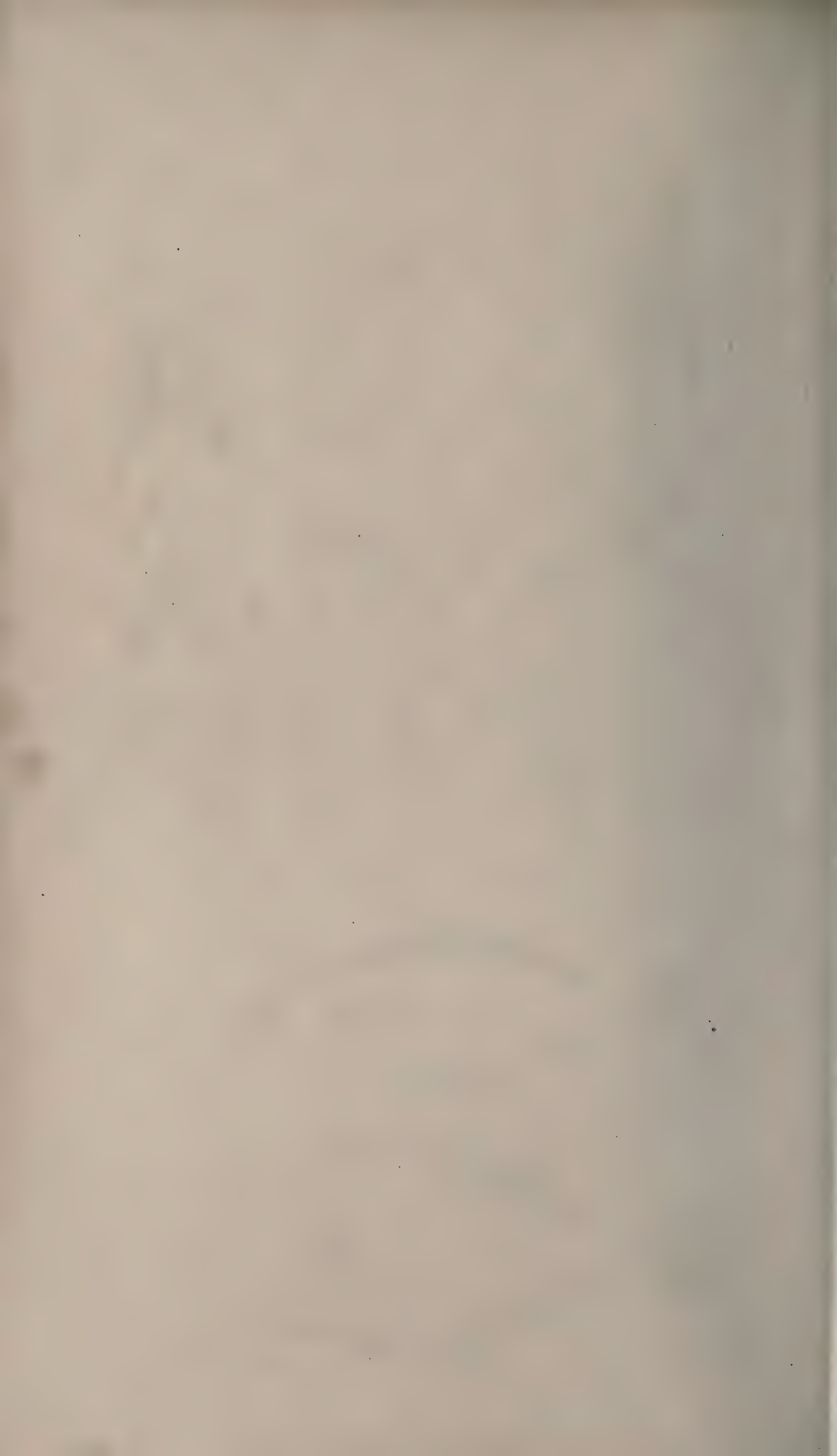




Fig. 1.

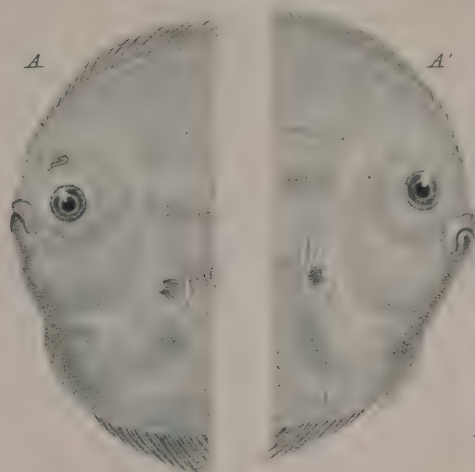


Fig. 2.

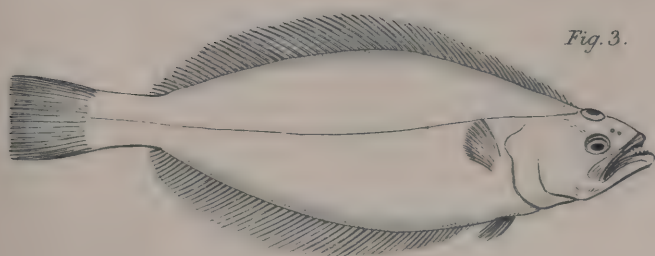
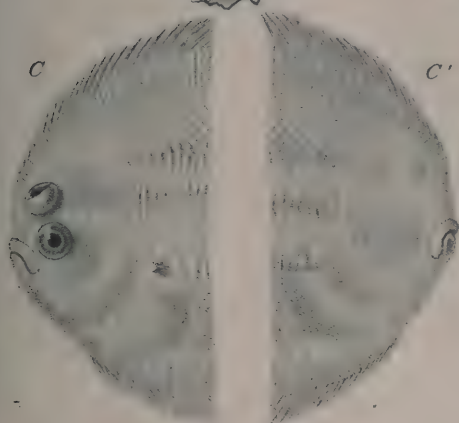


Fig. 3.

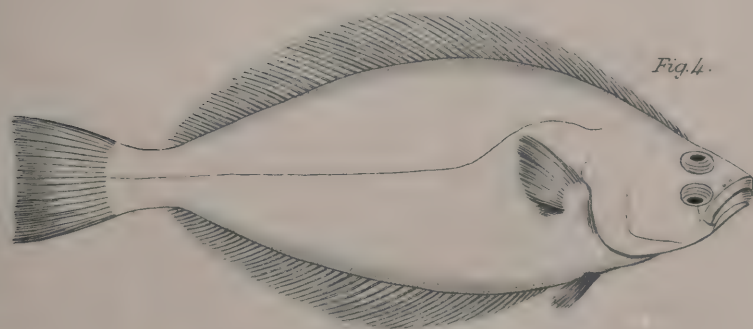
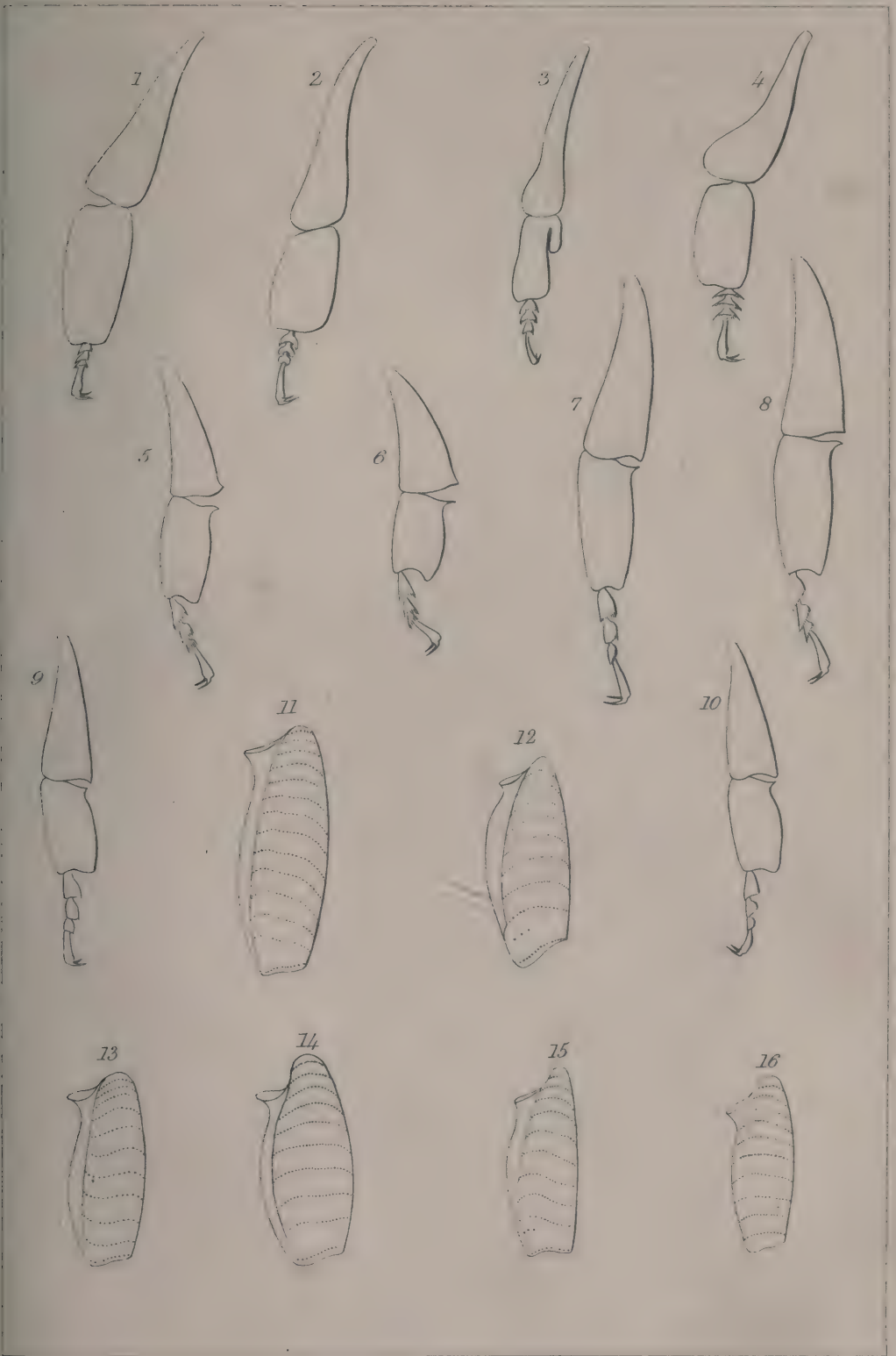
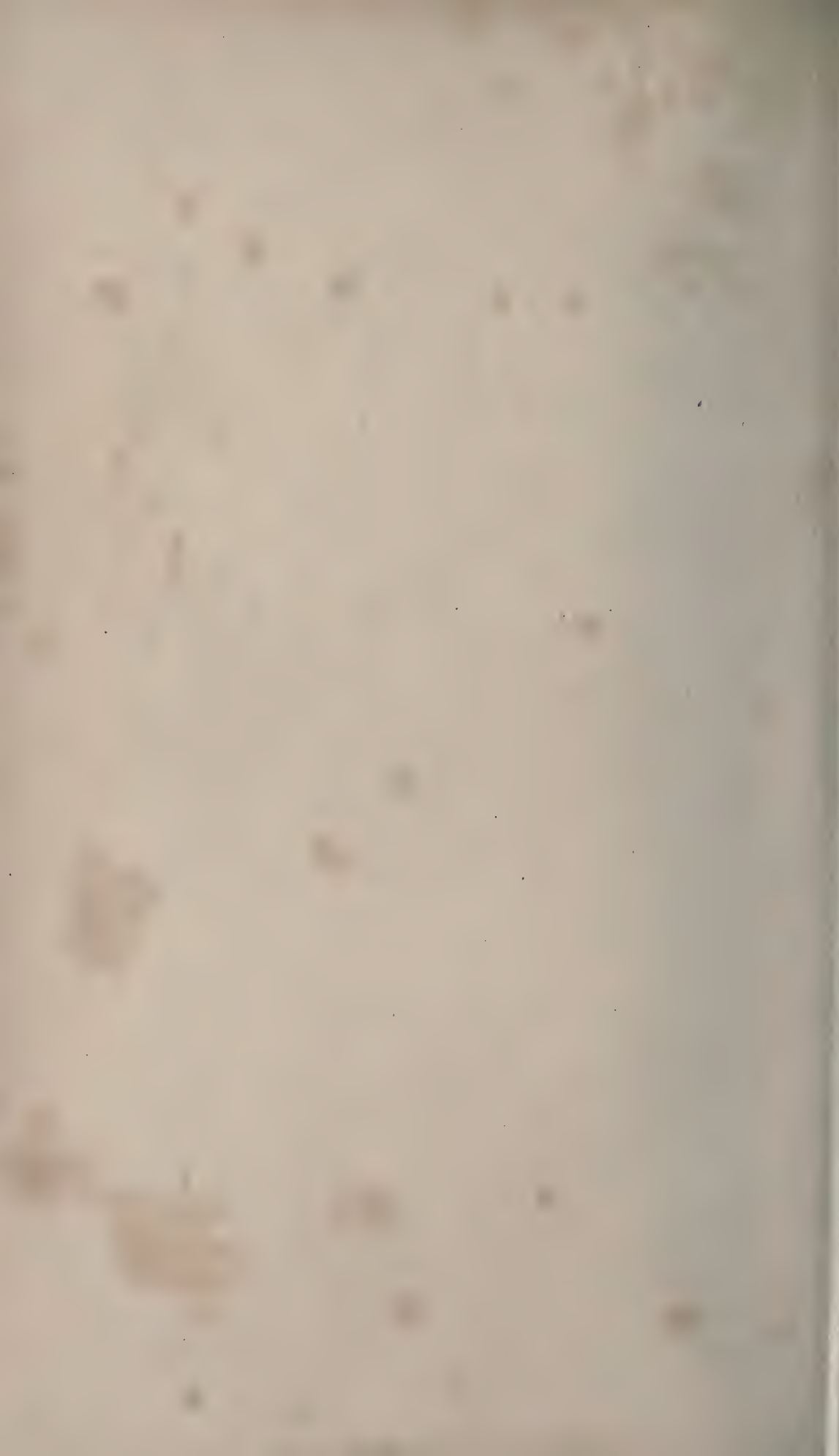
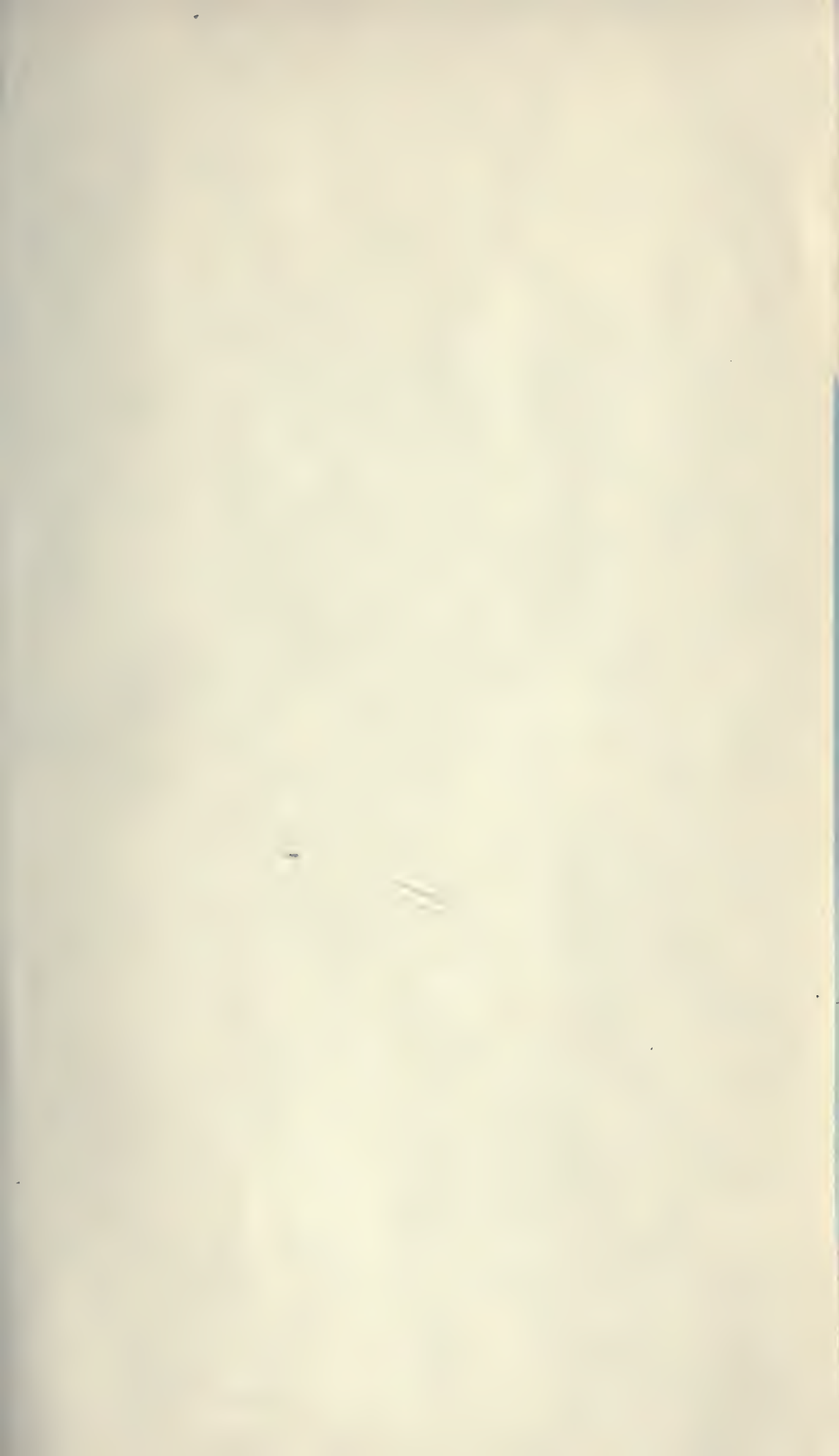


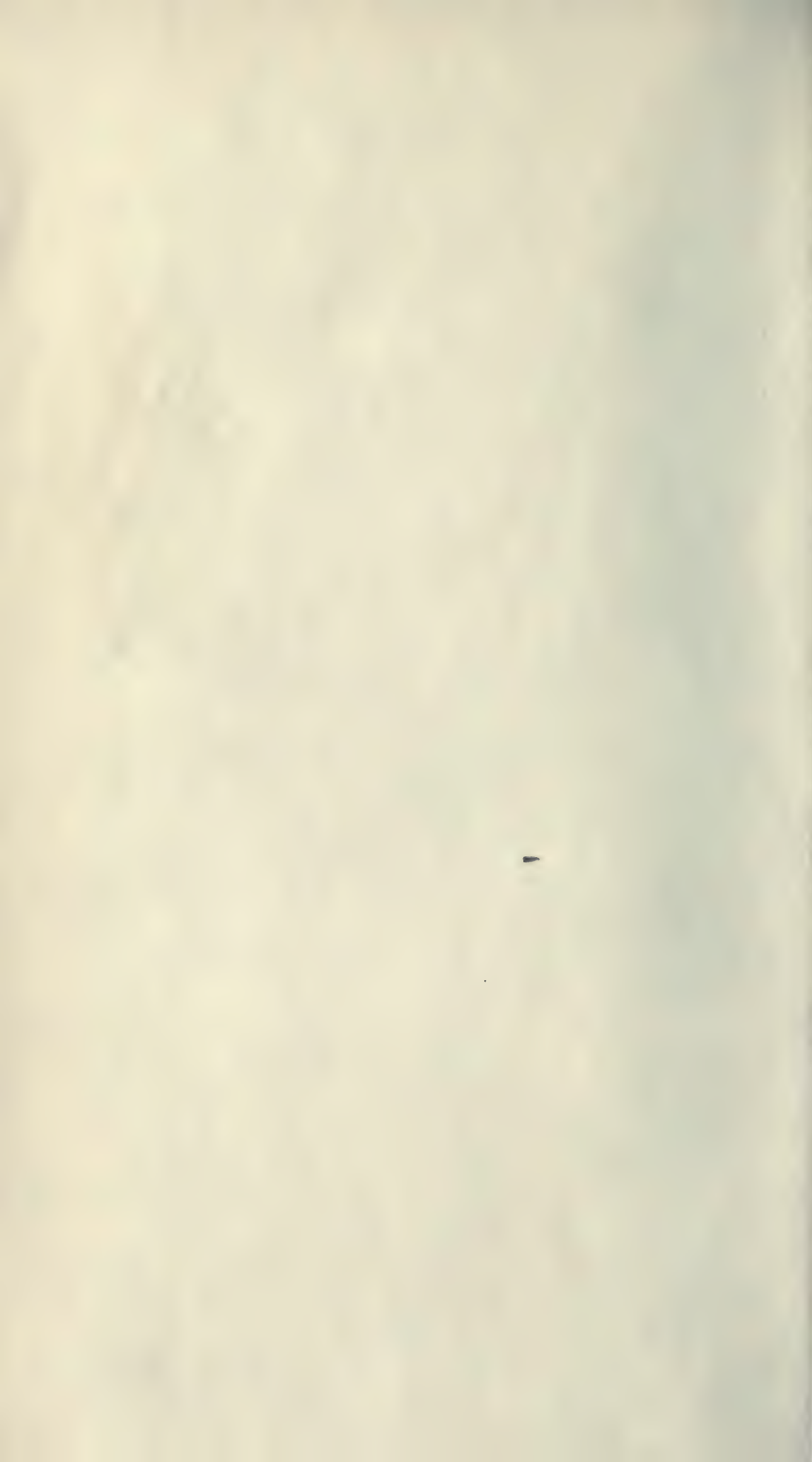
Fig. 4.











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